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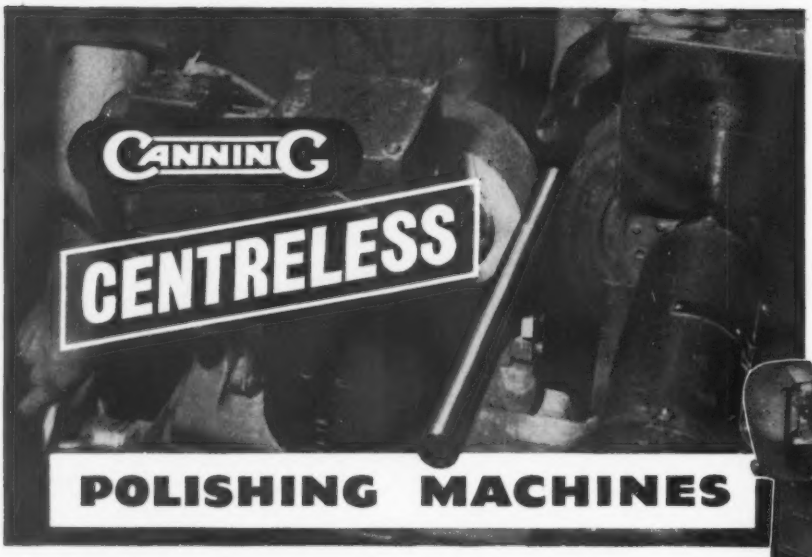

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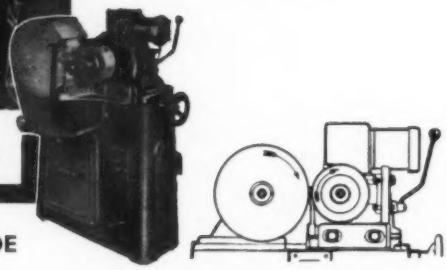

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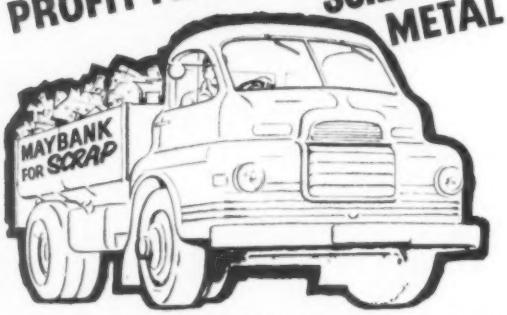

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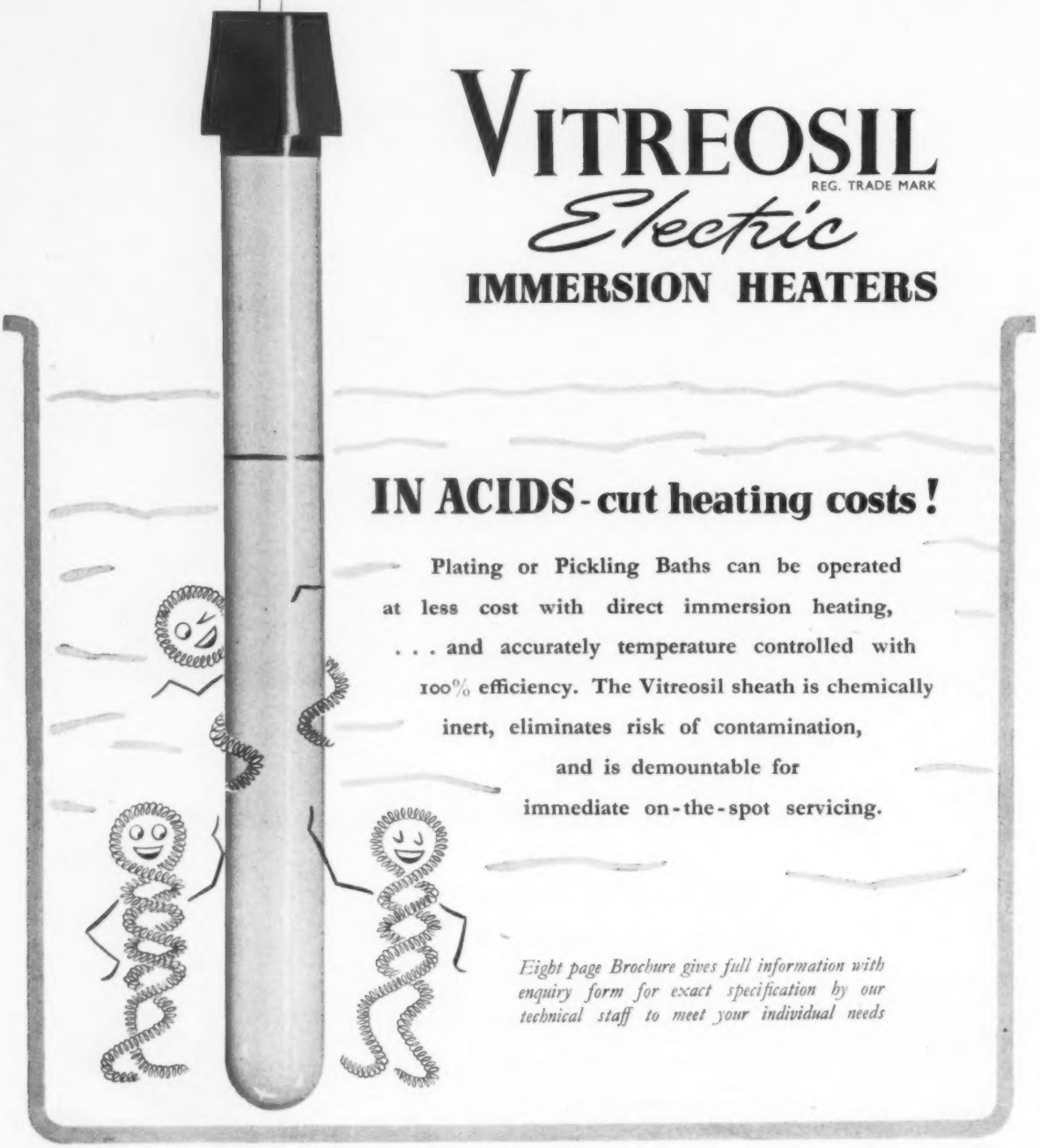

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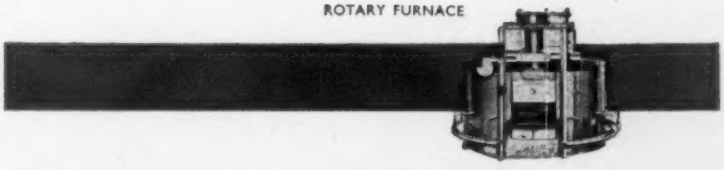

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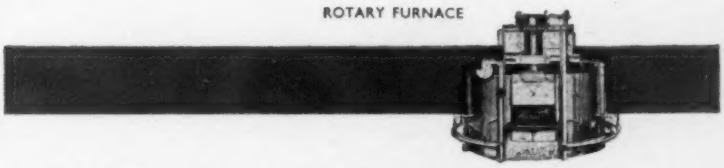

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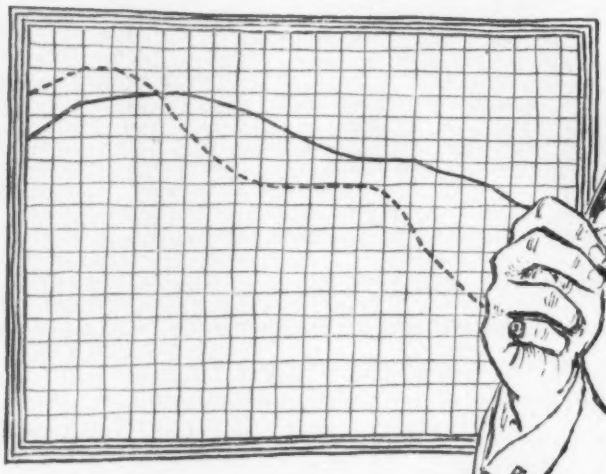

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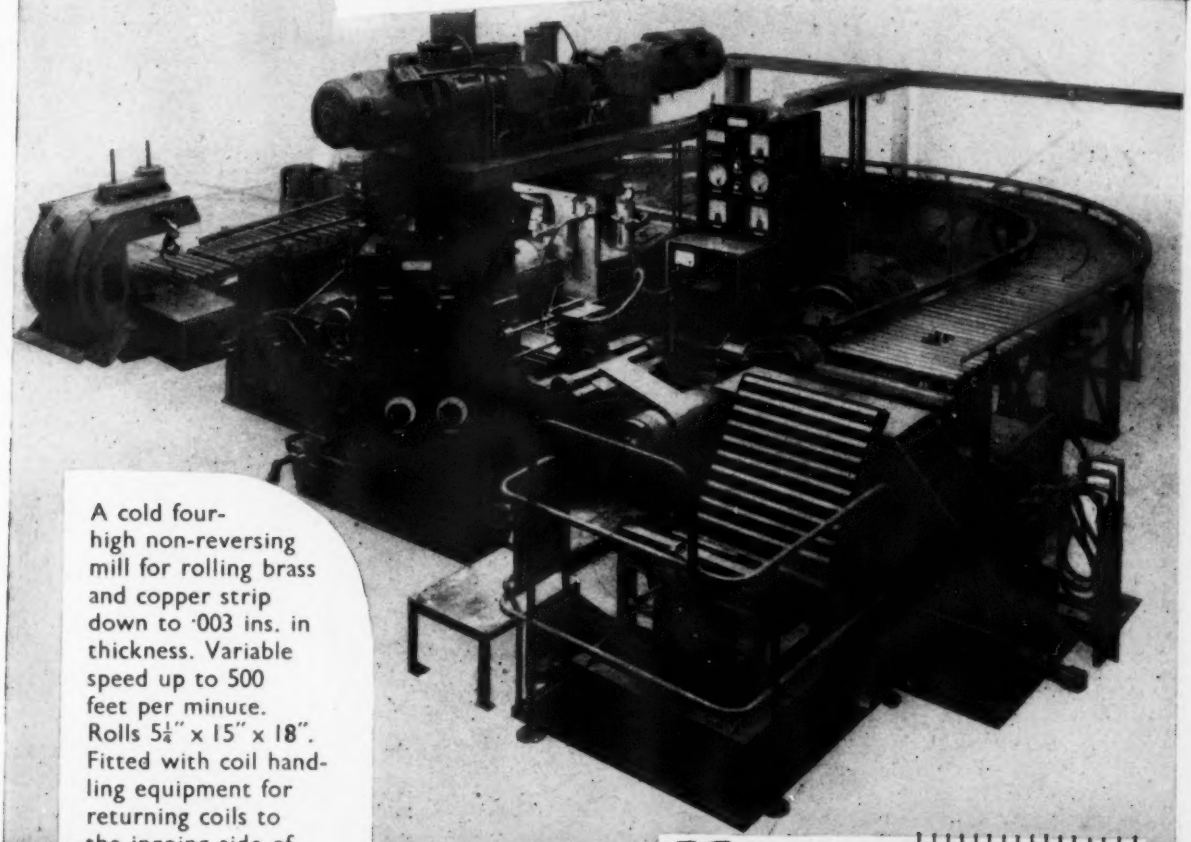

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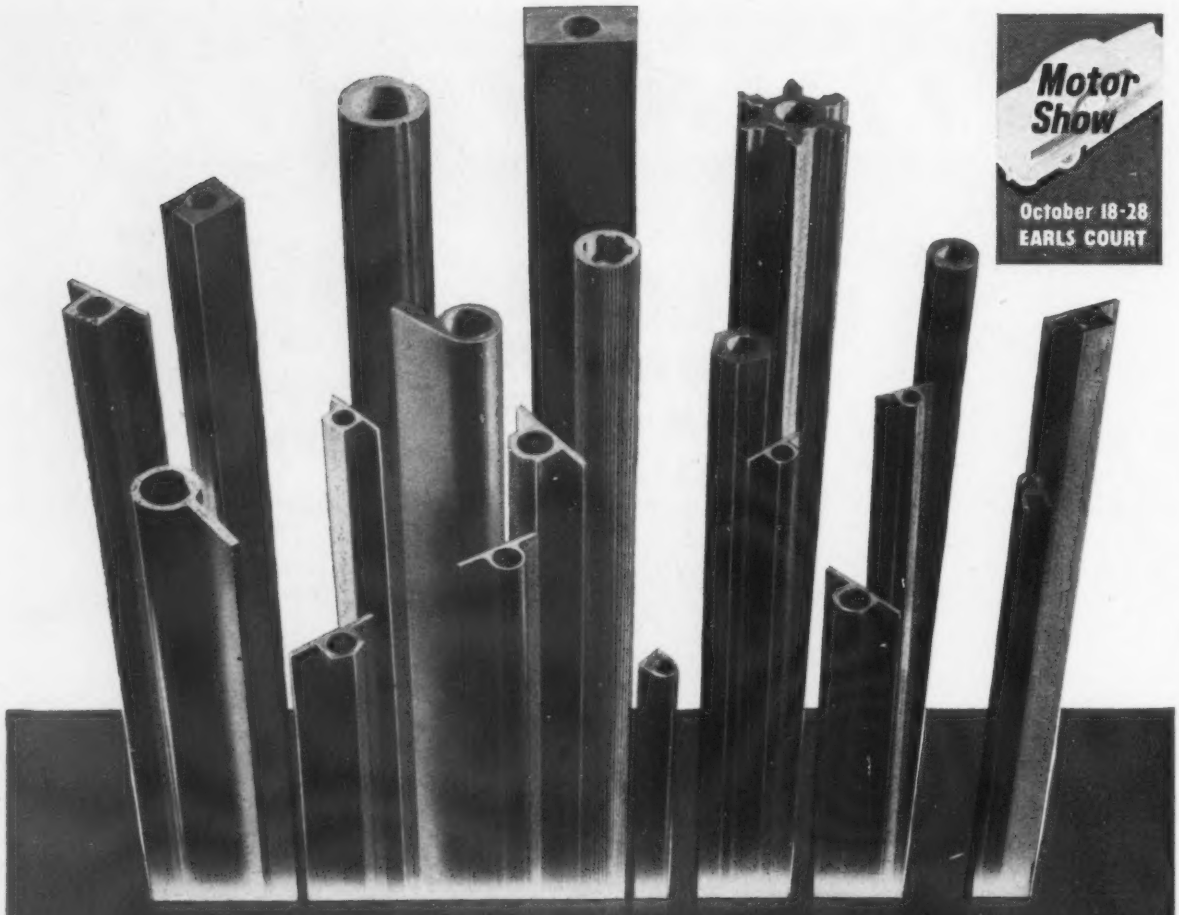

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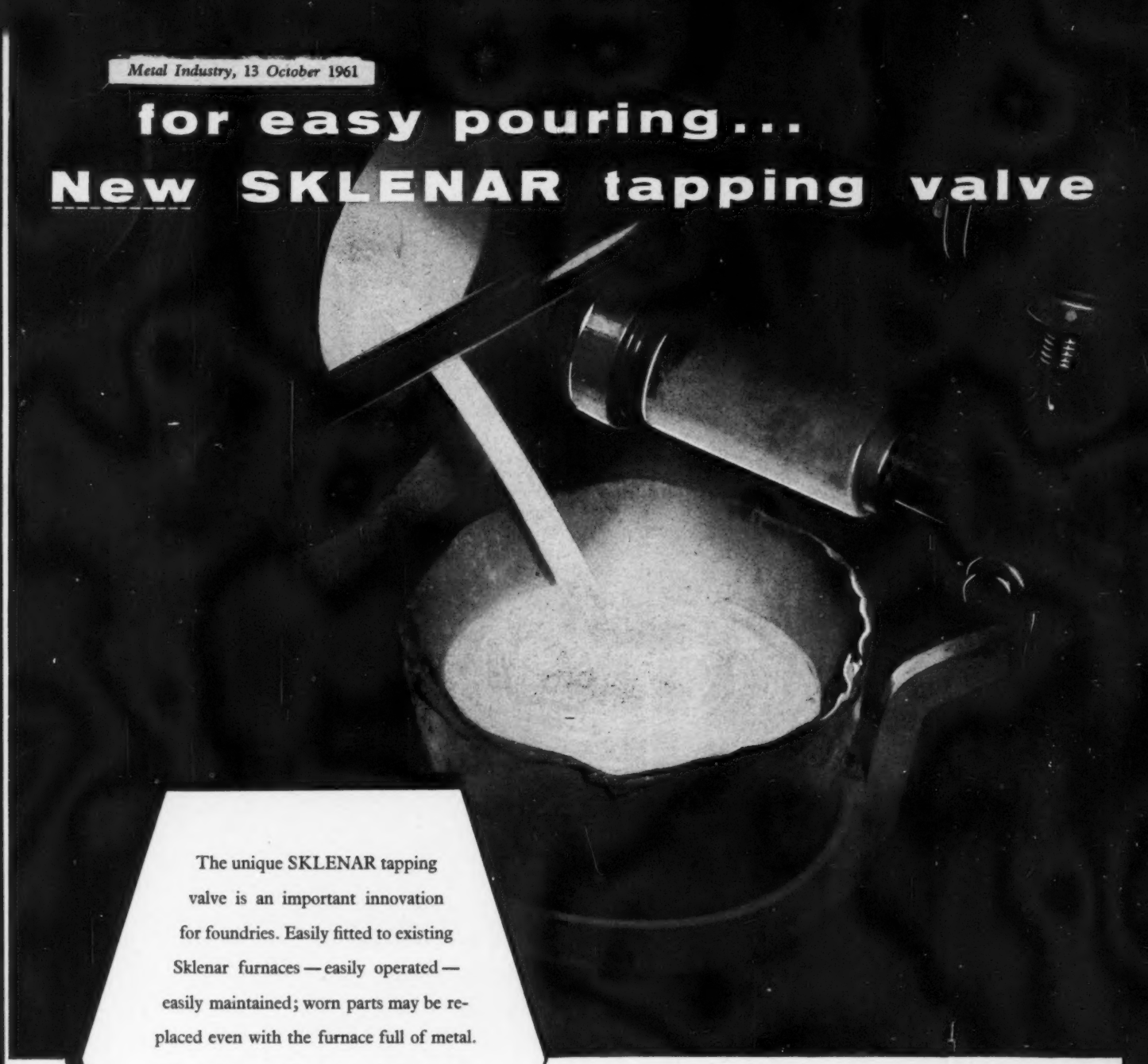

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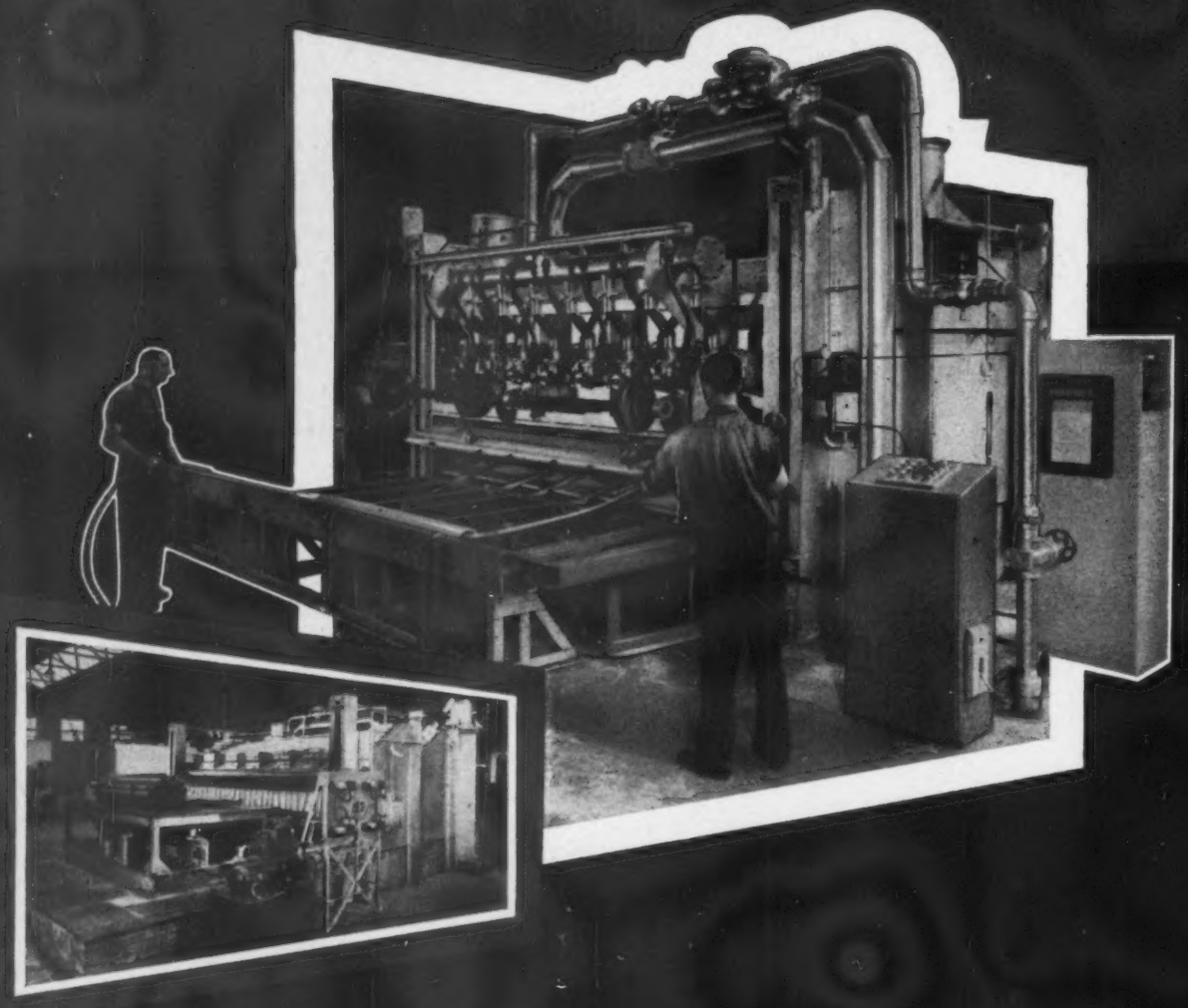

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METAL INDUSTRY

FOUNDED 1909

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PUBLISHED EVERY FRIDAY BY ILIFFE PRODUCTION PUBLICATIONS LTD.
Editorial Offices: 9 Charlotte Street, Birmingham 3. Telephone: Central 3206

Advertising and Publishing Offices: Dorset House, Stamford Street, London, S.E.1.
Tel.: Waterloo 3333. 'Grams: "Metustry, London-S.E.1"

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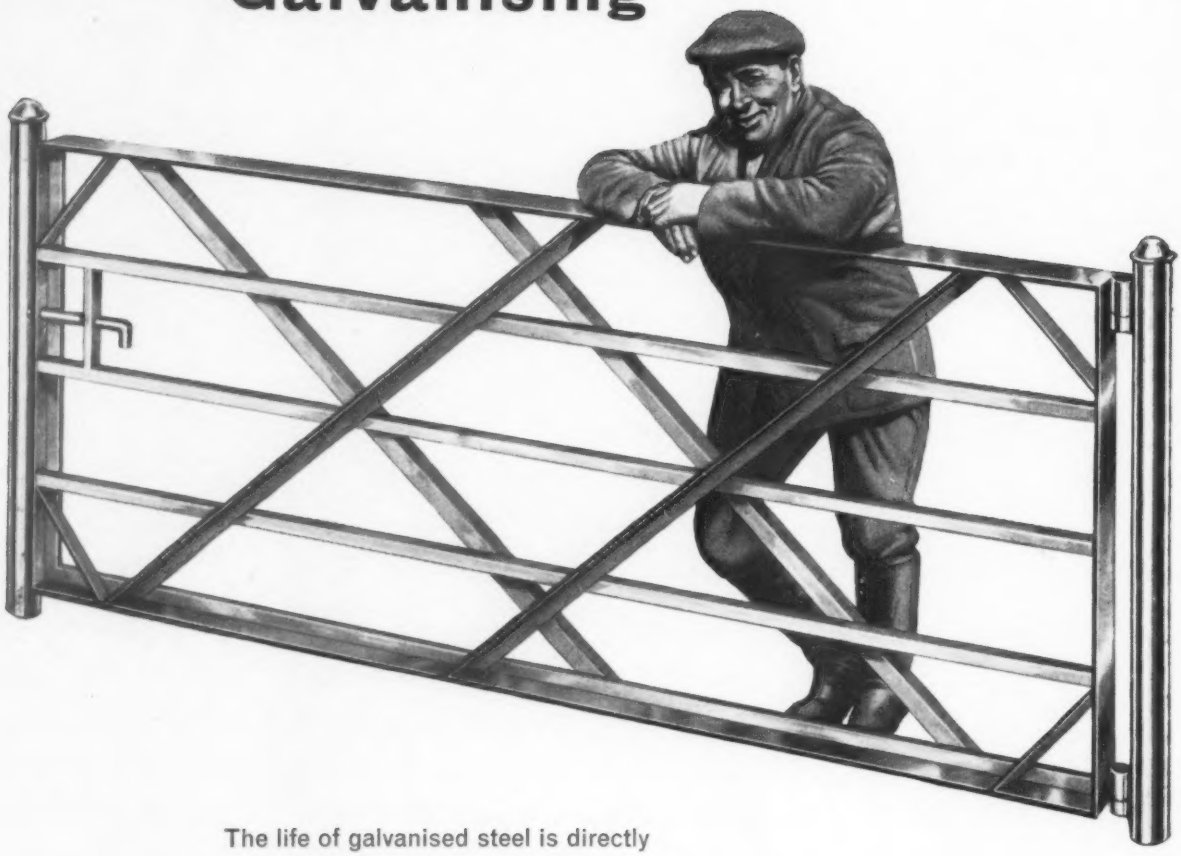

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Experience Shared

SOME of the hopes and fears, as well as more constructive ideas, of the gravity and pressure die-casting industries were ventilated at a one-day Symposium held last week in Birmingham under the auspices of the Light Metal Founders Association. The subject of the meeting was "Die Design", and two Papers were presented on aspects of design affecting gravity die-casting; another dealt with pressure die-casting, and a final Paper reviewed some American pressure die-casting plants visited last year by delegates to the Die-Casting Congress. The Symposium reflected the current interest in design problems, as well as indicating the decline of the "keep-it-dark" attitude which has so bedevilled relations between firms in all industries, resulting in endless duplication of fruitless experience and thus retarded progress and development.

Discussion followed the presentation of each of the Papers, and very lively it turned out to be. Among the many topics that arose in connection with gravity die-casting was the question of competition from pressure die-casting. Several speakers seemed to feel that this competition was serious, although one of the authors had pointed out that in the U.S. and elsewhere the trend towards large-scale production of cylinder blocks, crankcases and similar castings had not met with the success that pressure die-casters had hoped for. The need for the utmost mechanization of the gravity casting process was emphasized, and it was pointed out that the cost of pneumatic equipment was low in relation to labour costs and to that of remelt metal being used as runners and risers. A careful examination of current ideas on the question of the relative merits of top and bottom feeding for gravity dies seems to be necessary, as well as an assessment of the value of standardized tilting mechanisms, and hydraulic and pneumatically-operated devices for minimizing manual effort and skill. Clearly, opinion differs widely on these matters.

Greater standardization of pressure die-casting machine parts as an aid to interchangeability was also stressed. Die-casters are constantly faced with the problem of dies which can be run on one machine only, and here a more versatile machine design would be of considerable help. Similarly, standardization of other parts offers scope for production economies. From the descriptions of American die-casting plants, it is clear that practice varied very widely, both at the design stage and on the foundry floor, from plant to plant. While there is probably not such a wide range of conditions within the industry in Great Britain, there is considerable variation in practice, as indicated by the discussions. In an industry serving so diverse a field, this is a healthy situation, and both gravity and pressure die-casters can learn from each other's successes and avoid each other's mistakes, if such Symposia continue to provide opportunities for sharing experience.

One of the fears raised at this meeting was that of the competition likely to ensue from our entry into the Common Market—a problem not confined to die-casting. If competition is to be met, as indeed it must be, the utmost co-operation between all concerned is of vital importance.

Corrosion

SECOND TECHNICAL SESSION AT THE INSTITUTE OF METALS AUTUMN MEETING

AT the Autumn Meeting in Brussels of the Institute of Metals, one of the Technical Sessions, held on Thursday, September 21, dealt with "Corrosion". Six Papers were briefly reviewed and commented on by the Rapporteur, **Mr. E. A. G. Liddiard.** They were: "Stacking Faults and the Failure of Alloys in Corrosive Media", by P. R. Swann and J. Nutting; "The Propagation of Corrosion Pits in Metals", by C. Edeleanu; "The Exfoliation Corrosion of Aluminium Alloys", by E. A. G. Liddiard, J. A. Whittaker and H. K. Farmery; "Prevention of Exfoliation Corrosion of an Aluminium Alloy (HE 15) by Extended Ageing", by W. A. Bell and H. S. Campbell; "The Prevention of Exfoliation Corrosion of Aluminium Alloys by Sprayed Metal Coatings", by V. E. Carter and H. S. Campbell; "Atmospheric Corrosion Behaviour of Two Structural Aluminium Alloys (H 10 and H 15)", by E. A. G. Liddiard and J. A. Whittaker.

In his remarks introducing the Papers, **Mr. E. A. G. Liddiard** said these Papers fell into two distinct groups. The first two, by Swann and Nutting and by Edeleanu were concerned essentially with corrosion mechanism, and the last four with observations on atmospheric corrosion behaviour of structural aluminium alloys.

The contrast between the first two was interesting. Swann and Nutting approached the problem from the point of view of preferential attack at susceptible regions in the lattice structure using thin foils of copper-base alloys, and Edeleanu made the electrochemical approach using thin films of super-pure aluminium. In his introduction, Edeleanu made the somewhat controversial statement that "stress corrosion constitutes an extreme case of pitting". Both used electron microscopy to study progress of corrosion or cracking in thin foils. Swann and Nutting took thin films of copper-base alloys and studied the attack during electropolishing. This sometimes takes place along stacking faults preferentially (copper-zinc and copper-aluminium); sometimes it is stated that stacking faults are selectively unattacked (copper-germanium and copper-silicon).

The evidence for the latter observation seems less convincing than for the former. The same is true for the explanations. It is reasonable to assume that the chemical activity will be greater at a stacking fault owing to the higher energy state of the disarranged material, but the concept that the solute element may diffuse preferentially to stacking faults because the solubility is higher in these regions is rather difficult to accept, since stacking faults are in the atomic arrangement. It is, however, possible that there may be an "atmosphere" or clustering of solute elements in these regions as a preliminary to precipitation, but precipitation itself signifies that the solubility limit has been exceeded. This clearly would not occur if the solid solubility had increased. The incipient precipitates could easily act as local cathodes.

P. R. Swann

Prof. J. Nutting

C. Edeleanu

It is also rather a long way from electropolishing, which these authors used and in which the conditions are chosen to produce a smooth and non-selective attack, to stress corrosion or corrosion fatigue where selective attack is postulated. However, some very interesting photomicrographs are included in support of the suggestion that selective corrosive attack takes place on stacking faults or immediately adjacent to them. These authors appear to have given insufficient consideration in their foreword and in the general discussion to the fact that the corrosive environment may determine whether the stress corrosion or corrosion fatigue cracking is intergranular or transgranular.

Edeleanu's Paper, after assuming that stress corrosion is a special case of pitting, sets out to show why the author considers that the rate of attack per unit of active area in a pit should be constant for a given metal solution system. He expresses the view, early on in the discussion, that a metal or region in a pit is anodic because it corrodes, and not vice versa. This point should be made firmly before each and every electrochemical discussion on corrosion electrochemistry.

Working with super-purity anodized aluminium foil, Edeleanu studies progressive attack in substantially one direction only. The technique he uses of an anodized and lacquered foil may seem to simulate the filiform type of attack one sometimes finds under lacquers and similar films, rather than the more typical penetrative type of pit that is partly, if not fully, controlled by external cathodic areas of the metal freely exposed to the corroding environment. However, such areas are normally polarized by the accumulation of reaction products and cathodes frequently develop inside pits. The external platinum cathode used to initiate and maintain the attack seems highly artificial and will prevent cathodic areas forming inside the pit, with consequent hydrogen evolution development. However, the observations that this author makes on the form and progress of these pits or tunnels are of great interest. The next step would presumably be to show that when a stress is applied the tunnels become more nearly unidirectional, following the preferred direction of dislocation movement. Even if this is so, it is still very different from stress corrosion, which is normally intercrystalline in aluminium alloys. Indeed, this form of corrosion attack appears to be quite unrelated to stress corrosion.

How would the authors of these two Papers explain the fact that the change from transgranular to intergranular stress corrosion attack can depend upon the environment, or that corrosion fatigue can change from 45° to 90° to the stress direction with changes in the level of stress, the mode of stressing, and the value of the applied current? This so-called cathodic polarization is only effective in improving resistance to corrosion fatigue if the mode of failure is 45° (shear). It is difficult to correlate these observations with preferential attack at stacking faults or with pitting.

The next group of Papers all deal essentially with collection of data or experience which can be used by engineers and others to predict the life and behaviour of aluminium alloys when exposed to the atmosphere.

The Paper "Atmospheric Corrosion of Two Structural Aluminium Alloys" summarizes exposure tests on a manganese-free magnesium-silicide alloy with excess silicon and a 4 per cent copper-magnesium alloy. The work, as originally planned, involved the preparation and exposure of literally thousands of specimens. The scatter in results was considerable even when replicate specimens were averaged to obtain a single point in the corrosion time curve, but by averaging all specimens of one alloy H10 from all sites a fairly good curve was obtained (Fig. 1 of the Paper).

An error has occurred in the scales showing equivalent loss in thickness in Figs. 1 and 2 in the Paper—the scale is shown correctly in Fig. 3. The points on this curve show a straight line if plotted on a log scale and similar types of curve have, therefore, been drawn for the alloy at the other sites and, by extrapolation of log plots, predicted equivalent loss of thickness based on loss of strength has been derived. Copper in amounts over 0·05 per cent is shown to decrease corrosion resistance, particularly in marine sites. Corrosion is found to occur more rapidly in this country than in U.S.A. at comparable sites (industrial, sea-coast, etc.) but the decrease in corrosion with time has been confirmed. If depth of intercrystalline attack is taken as a measure of corrosion damage, attack seems much more serious than judged by loss in strength (Fig. 5); at the same time, the tendency to decrease with time is much more marked. This relatively rapid penetration and stifling of the intercrystalline corrosion in H10 alloys is probably mainly responsible for the rather unjustified condemnation of the manganese-free magnesium silicide alloys which has resulted in this specification now being dropped in the U.K.

The behaviour of the H15 alloy contrasts with that of the H10 in that, after about two years' exposure in severe atmosphere, exfoliation corrosion occurs, causing a breakaway in the logarithmic curve to something more like a linear curve. This very serious form of corrosion has been investigated in greater detail in the other three Papers to be considered at this session. In view of the importance to the shape of the corrosion damage curve and the severe scatter normally encountered in replicate tests, Whittaker and I have used a deflection test as a measure of corrosion damage which allows a single specimen to be used throughout the test.

This form of test can be commended to those interested in atmospheric corrosion testing of aluminium alloys, since the shape of the corrosion damage/time curve is all-important in predicting long-term service behaviour.

Using this technique, there is no evidence of decreasing damage with time except for short periods following a rapid change from one linear rate to another, which can easily be correlated with the penetration of a recrystallized skin (Fig. 4). The B.N.F.M.R.A. have relied on visual examination for assessment of corrosion damage. Both B.N.F.M.R.A. and Fulmer Research Institute investigators agree that metal spraying is an excellent way to prevent layer corrosion, and it is effective when gaps in the coatings exist (B.N.F.M.R.A.) or when applied to material which has started to corrode (F.R.I.). The B.N.F.M.R.A. find painting less effective than spraying but have had excellent results using paint on top of sprayed coatings. There is also general agreement that the most severe form of exfoliation attack can be prevented by overageing. The B.N.F.M.R.A. investigators think this need only cause a reduction in 0·1 per cent proof stress of around 1 per cent provided the copper content is high. Incidentally, one result in Table III, p. 466, is rather odd: 72 hr. ageing at 185°C. shows a V.P.N. hardness drop compared with normal 7 hr. ageing from 152 to 129, but the proof and ultimate tensile have risen from 25½/29½ to 27/32. In our view, the ageing necessary to prevent the most severe exfoliation is likely to reduce the mechanical properties by about two tons and require a reduction in specification minima by about this amount. There is some discrepancy, too, in that in our work no severe exfoliation attack was observed until after four years' exposure at Euston, so that a final decision on the efficacy of extended ageing will have to await longer term testing in normal atmospheres. We have found the aluminium-copper-cadmium alloy to be immune from stress corrosion, and this may be said to represent the third way of preventing exfoliation in the high strength structural alloys. The B.N.F.M.R.A. investigators have pointed out that with experience one can judge susceptibility to exfoliation from the microstructure, but neither group has so far succeeded in formulating a test for susceptibility which could be incorporated in a specification.

Some attention might be given in discussion to the general question of the shape of the time-corrosion curve. We consider this to be logarithmic and so does Champion, unless he has changed his views. The logarithmic curve is preferable because on a log plot it cuts the horizontal log time axis at a finite time with no damage, which corresponds with the incubation period. The corrosion experts from Alcoa, while agreeing that the corrosion decreases with time, normally draw their curves starting with a logarithmic type of curve and merging into a linear plot, with a small slope.

E. A. G. Liddiard

J. A. Whittaker

H. K. Farmery

Miss W. A. Bell

H. S. Campbell

V. E. Carter

Goddard has suggested that, for pitting in waters, corrosion damage rate decreases as the cube root of time. There is some theoretical justification for this if one considers a pit as a spherical surface corroding at a constant rate. Plotting our results on a cube basis, the curves do not lie on such a good straight line, but extrapolation gives about the same depth of attack in a hundred years as was found using the log plot, so that the differences are of rather academic interest. However, the practical significance of the departure from the logarithmic curve when layer attack takes place must not be overlooked, and these predictions for long life presuppose freedom from layer or exfoliation attack.

Another point which might be worth discussing is whether or not manganese should be added to these magnesium-silicide alloys with some excess silicon. Manganese certainly imparts a greater directionality in the structure and causes a finer grain in recrystallized material. This has the effect of reducing the initial rate of intercrystalline penetration, but in the longer term it is unlikely that the manganese-bearing alloy will show any advantage. One might even have some doubts, particularly if the alloy has not recrystallized after working, whether the alloy will be entirely free from layer corrosion.

Discussion

Referring to the Paper by Swann and Nutting, **M. Milbourn** (Imperial Chemical Industries (Metals Division) Limited) said it implied in places that there were relationships between stacking fault energy, composition and stress corrosion behaviour, but no precise conclusions were drawn in respect of such relationships. Thus, brasses and bronzes have low stacking fault energies but in the case of alpha brass it is lower than that of copper. Furthermore, there is a difference in stress corrosion behaviour between copper-zinc and copper-aluminium alloys on the one hand and copper-silicon and copper-germanium alloys on the other. Would the authors care to expand on the relationships between stacking fault energy, composition and stress corrosion behaviour?

Precautions had rightly been taken to prevent oxidation of

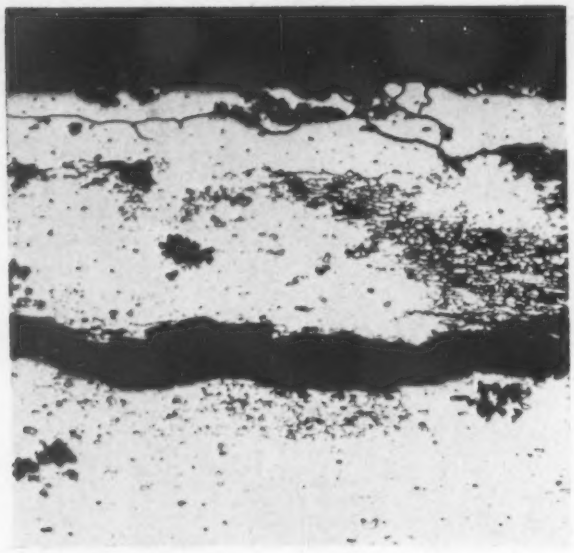


Fig. 1—Result of test on fully-aged HE15, with outer band not machined off. (× 200)

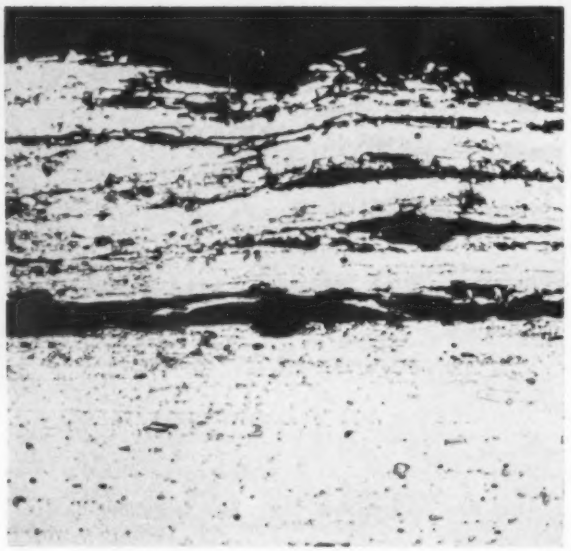


Fig. 2—Result of test on fully-aged HE15, with outer band machined off. (× 200)

the specimens used in this work, but in other experimental work or in practical examples an oxide film would almost certainly be present. Was it likely to have any significant effect on the initiation or propagation of stress corrosion cracks?

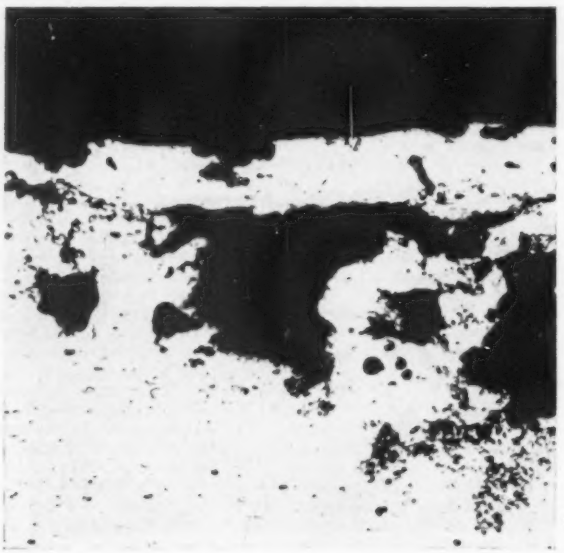
In the Paper by Liddiard and Whittaker, the H10 alloy used had a low manganese content, but there is an alternative material which contains manganese as an added constituent. Former work in this laboratory had demonstrated that in aggressive laboratory tests, using a rolled sheet, the manganese-containing alloy suffers less intercrystalline attack and is not as sensitive to stress corrosion as the manganese-free alloy. Similar evidence in respect of extruded materials is not as clearly cut, and from their behaviour in service it is evident that there is little difference in performance of the two types of H10 alloy in mild atmospheric environments. However, there is some evidence that in aggressive atmospheres the manganese-containing extrusions are superior, but the observations could be explained by assuming that there has been some uncontrolled variation in the manufacture of low manganese material. Further investigations would be needed, therefore, before all aspects of the behaviour in service of H10 alloys can be explained.

The authors have rightly emphasized the differences between results obtained in their atmospheric exposure tests and those obtained in somewhat similar environments in the U.S.A. It is difficult to believe that such differences are due to a subtle difference between the materials, but it might nevertheless be worth while ascertaining whether any differences were observed, between the States and this country, in laboratory tests as distinct from outdoor exposure tests.

It seems more likely that the conditions encountered at the exposure sites in the two countries were not strictly comparable and it would be interesting to know the grounds upon which sites were chosen for comparison. This point may be expanded by reference to recent investigations in U.S.A. and in Russia, which have suggested that corrosion under thin films of moisture lying on the surface of a metal is greater than when the metal

Fig. 3—Result of test on fully-aged HE15, material from centre of extrusion. (× 200)

Fig. 4—Result of test on slightly-overaged HE15, with outer band not machined off. (× 200)



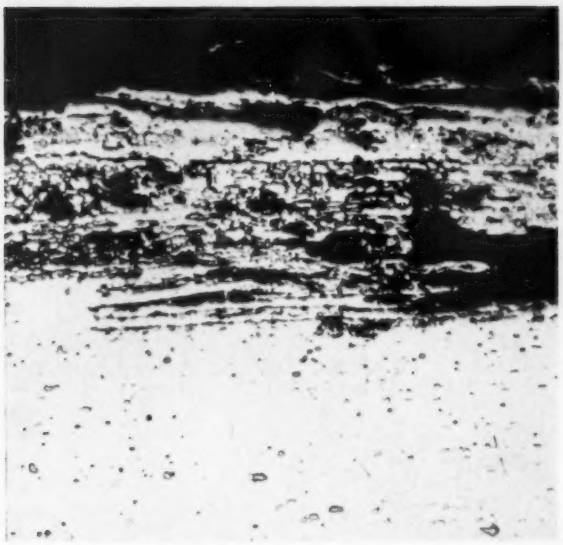


Fig. 5—Result of test on slightly-overaged HE15, with outer band machined off. (×200)

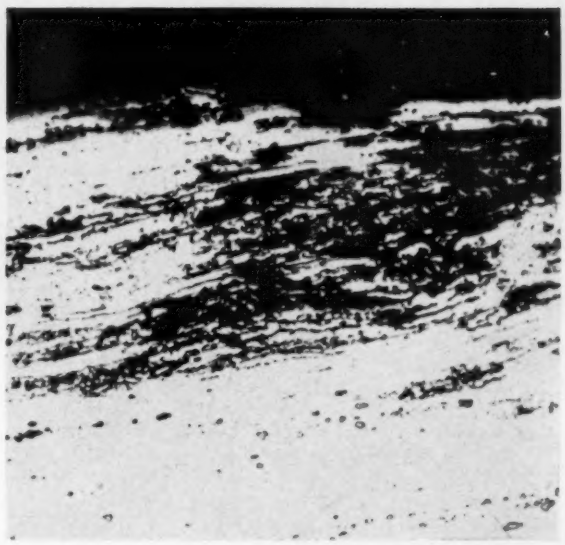


Fig. 6—Result of test on slightly-overaged HE15, material from centre of extrusion. (×200)

is completely immersed. It is logical to believe, therefore, that if two outdoor exposure sites are to be classed as similar, the metal at both sites should remain wet over approximately the same period each year. This is related to the number of occasions on which there is rainfall rather than the yearly average for rainfall or humidity. The degree of atmospheric pollution is, of course, also a vital feature. Is any information available to indicate whether Sheffield and Altoona, for instance, have similar characteristics for either of these criteria? Furthermore, could a location be chosen in the States where the day-to-day variation in weather is similar to that in this country?

Commenting on the Paper by W. A. Bell and H. S. Campbell, in a contribution which was presented by Dr. Gardam, **M. K. Budd** and **F. F. Booth** (Aluminium Laboratories Limited) said that some tests had been carried out on material provided by Miss Bell and Campbell, in which a recently developed potentiostatic etching test had been used. Results were obtained similar to those described in the Paper, and the alloy microstructures after testing using the potentiostatic method are shown in Figs. 1-6.

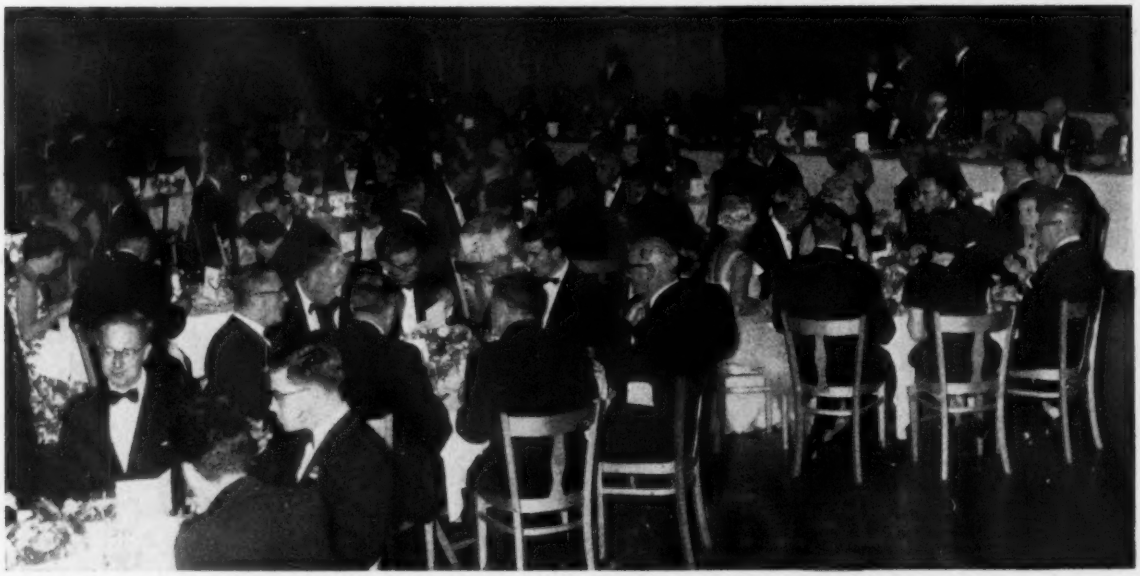
The findings confirm that the outer bands of these extrusions are not susceptible to layer corrosion, as is the fibrous material below them. In addition, material from the centres of the extrusions appears to be somewhat less suspectible to layer corrosion than that immediately below the outer band. This confirms a suggestion from Bell and Campbell. The slightly-overaged material is clearly considerably less susceptible to layer corrosion than the fully-aged material.

The test involved potentiostatic etching of small specimens (2 cm^2 exposed surface) in 3 per cent sodium chloride at a potential of −0·60 V (s.c.e. scale) for 16 hr.

It is of particular note that the results obtained by the potentiostatic test, taking a few hours for completion, corresponded to those obtained after some weeks' exposure to salt spray at high humidity, and to some months' exposure in natural environments.

(To be concluded)

Some of the guests at the Concert Noble where the Institute of Metals autumn meeting banquet and dance were held



OUT OF THE MELTING POT

Unconventional Reminder

A CONVENTIONAL method need not always be the best, the easiest, the cheapest or even the most obvious. It may be no more than the method that came to mind first, or the first that was found to perform the particular job successfully. There will, however, always be circumstances, restricted though they may be, in which it will be the best, the easiest and the cheapest. However strong the hold of the conventional, the unconventional does sooner or later succeed in making its appearance upon the scene, very often in the wake of something else, which in its way is also unusual. Such occasions can then be profitably used as opportunities to reconsider the conventional. Consider, for example, the recent interest in that certainly still unusual metal, beryllium. Among the various special techniques required in working and fabricating this metal, the simple method of producing shaped bodies by filling loose beryllium powder into a mould and sintering the powder in the mould without the application of external pressure either before or during the sintering, has been regarded as sufficiently unconventional to merit patent protection relating more particularly to a preferred particle size distribution and to the use of cores which are removed by melting at the sintering temperature, after the loose powder has been made to cohere by presintering at a lower temperature. Loose sintering of metal powders is by no means new, but still unconventional by contrast with the conventional use of heavy presses, expensive and often complicated dies, and the sintering of the metal powder compacts. If, however, it succeeds in producing shaped beryllium bodies having bulk densities of about 98 per cent of that of solid beryllium, could it not do the same for more common and more amenable metals? Its use would admittedly involve thoughts being given to particle size compositions, choice of materials for the permanent or temporary moulds, and to sintering conditions. Once a break with the conventional has been made, thoughts might even be allowed to wander into the foundry field, where some of the recent moulding techniques could perhaps be examined for utility in connection with loose sintering.

To Slumber

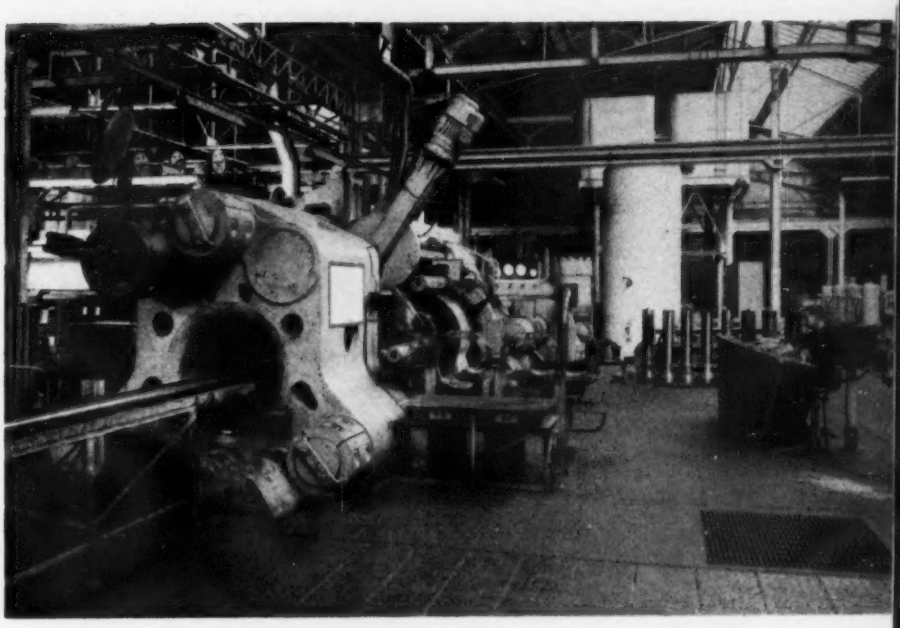
PARENTS of young children skilled in the art of getting them to fall asleep will be familiar with the dodge of providing the comforting presence of some beloved toy and also with the difficulty of ensuring that the child remains covered. The dodge and the difficulty have now been dealt with in "an infant slumber inducing means for use in mentally conditioning an infant and promoting sleep, said means comprising, in combination, a conventional type cot blanket the marginal edges of which are adapted to be tucked-in in the usual manner for retention on a mattress, a sleep-promoting object expressly designed and adapted to be caressingly cuddled by the infant, and means separably connecting said object to a selected portion of the blanket, whereby the inherent properties of the object itself and its attachment to the blanket will minimize the likelihood of the blanket being displaced from its intended infant-covering position, said object comprising a plaything, for example, a stuffed duck, of a type which has the desired appeal to the infant, said connecting means comprising an elastic tethering element connected at one end to the object and separably connectible at the other end to the blanket".

Against Hope

JUDGING by the ever-recurring references in the literature, work is still continuing on methods of protecting refractory metals, in particular molybdenum, against catastrophic oxidation by air at temperatures below those at which the mechanical properties of these metals would otherwise permit them to be used. Conversion coatings, metallic and non-metallic coatings deposited by various methods, and combinations of such coatings are all still, it appears, receiving consideration. The strength of the inspiration behind this continuing research and of the promise of the goal it is hoped to reach can be gauged on the basis of what has already been tried in the past. The delay of a few years between the application for a patent and its acceptance and publication results in recently published patents providing useful means for this particular purpose. Using them to glance back at what was being done five or six years ago, one is surprised that any hope could have survived, for example, such a "last hope" solution of the problem of protecting molybdenum as the provision of a "plurality of alternating chromium and nickel coatings," e.g. a 0·0005 in. thick layer of chromium followed by a 0·0007 in. thick layer of nickel, a 0·0003 in. thick layer of chromium, a 0·0007 in. thick layer of nickel, a 0·0003 in. thick layer of chromium, a 0·0007 in. thick layer of nickel, and a 0·0003 in. thick layer of chromium with, for good measure, a sheet metal (nickel) jacket, pressure welded to the outermost layer of the multiple-layer coating to provide protection against abrasion. Instead of simple multiplication, there is to be found, for example, the metallurgical complication of a molybdenum-base part with a metallurgically bonded surface system consisting of first, a nickel-silicon-boron flame-sprayed coating, an intermetallic chromium boride second layer metallurgically bonded to the first layer, and a chromium layer metallurgically bonded to the second layer, the chromium boride layer being the product of interdiffusion of the first layer and the third layer. Well-nigh impossible as it may seem, these six-year-old examples have no doubt been improved upon by more recent methods, and research is still going on. Hope does, indeed, spring eternal. . .

Skimmer

Visseries et Tréfileries Réunies



The new 2,500 ton extrusion press constructed by Hydraulik, Germany

FOUNDED in 1903, Visseries et Tréfileries Réunies acquired the installations of a company which had entered into liquidation and thus disposed of industrial buildings and offices covering an area of about 1¼ acres, together with the workshop machinery.

In the beginning the main object of the new company was the manufacturing of iron and brass woodscrews, as well as several other ironmongery products such as square-cornered hooks, rivets and screw eyes.

Strong competition in several world markets was encountered, but after some years export and home markets began to develop. A good part of the raw materials, however, had to be imported from abroad, which was a serious handicap to its further development along existing lines of production.

In view of the rich layers of copper ores in the Belgian Congo, and as the zinc industry in Belgium was well developed, a plant designed to manufacture brass wire for the screw factory was planned in 1908.

It was in 1912 that this plan was implemented and the material was ordered. The new plant started on August 1, 1914, when the First World War broke out, and the machinery of both divisions was sent to Germany and the buildings were requisitioned. In 1919, the company succeeded in retrieving enough of the material to enable the screw department to recommence its activities, and the wire-drawing department was also able to go into production.

The manufacturing programme of the latter, which in the beginning only involved the drawing of wire, was completed by a rolling plant for strip, and afterwards by a rolling plant for sheet: the rolling mill division was born.

In the meantime, the screw factory developed its programme in taking up the manufacture of metal screws, chains and other lines, and in 1929 a screw factory was established in France at Fourmies, which became the Visseries de Fourmies S.A.R.L. in 1932. This branch developed rapidly and became one of the leading screw factories on the French market.

The rolling mills division continued the extension of its programme by taking up the manufacture of seamless drawn tubes, rods and sections in brass and copper.

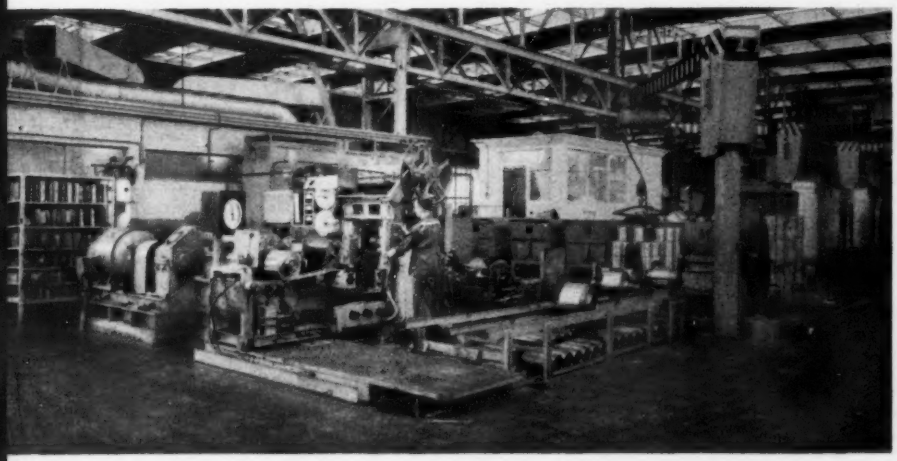
The Second World War unfortunately hampered again the progress of the company, but from 1945 on it took a new step forward by modernizing the installations and by improving the quality of its products.

The works at Haren and at Fourmies employ a staff of about 1,500 and cover an area of about 15 acres.

At the screw works, the manufacturing programme has been steadily extended. Although wood screws and metal screws can be considered as the main interest, considerable attention is paid to the manufacture of nuts, square-cornered hooks, screw eyes, cotter pins, screw hooks, gate and shutter hooks, lag bolts, threaded shanks, rivets, washers, rings, chains, and a lot of other articles produced by cold reduction of wire. All these articles can be supplied in iron, copper, brass and aluminium, and comply with the Belgian, British, American and other specifications.

The latest addition to this range of

Four-high finishing mill for copper and brass strip, 10 in. wide, 0·004 in. to 0·02 in. thick



General view of the mill shop with pickling lines on the left and annealing furnaces on the right

products is the self-tapping sheet metal screw, the production of which to very close tolerances has been made possible by the use of machine tools which incorporate the latest technical developments.

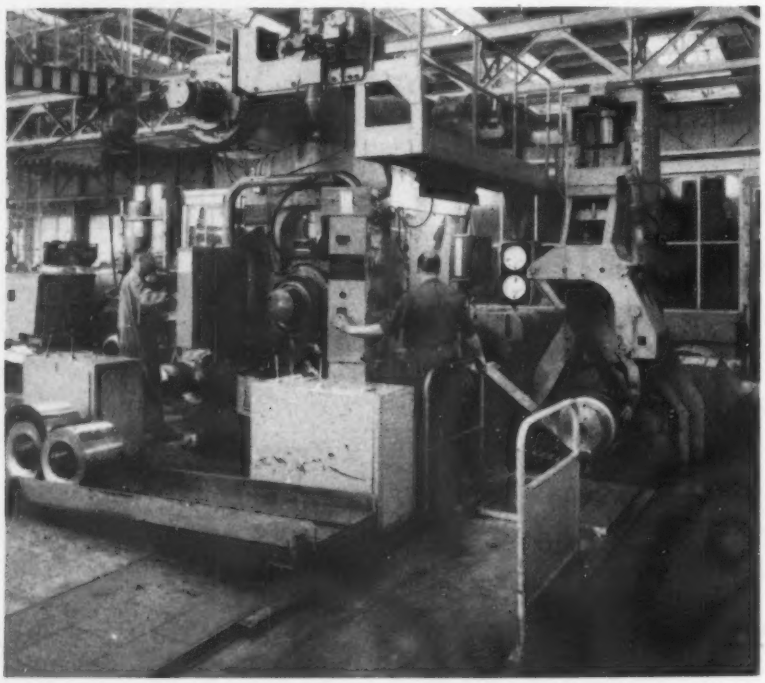
A modern installation enables the supply of these products in all desired finishes: chromium plated, nickel plated, galvanized, cadmium plated, blued, bronzed, etc.

In the course of its expansion the rolling mills division also made an important extension to its manufacturing programme, comprising semi-products in copper and brass and other alloys.

The main lines are: drawn products, in the shape of round, square, oval, half round and flat wire, and other specialities; rolled products such as sheets in different sizes, strip in coils and circles; extruded and drawn products comprising tubes, round and shaped; rods, round, square, hexagonal, flat, in brass, turning and boring, riveting, hot stamping quality, as well as in copper, for electrical conductors; sections in all shapes.

All these products are made in a large range of different alloys and undergo a variety of treatments, depending upon the end use for which they are destined and the service conditions likely to be encountered.

Four-high finishing mill operating at a maximum speed of 500 ft/min., for copper and brass strip 18 in. wide, 0·008 in. to 0·04 in. thick



Obituary

Mr. H. Knight

WE regret to record the death of Mr. Harry Knight, former managing director of George Jones Ltd., Lionel Street, Birmingham. He originally joined the firm as a draughtsman, becoming joint manager in 1921 prior to joining the board. He had been managing director for 12 years when he retired in 1959.

Le Centre National de Recherches Métallurgiques

Creep test laboratory for the study of steels for pipe work and superheaters

By L. Habraken

A NON-PROFIT-MAKING association founded in 1946, the Centre National de Recherches Métallurgiques has as its aims the improvement of metallurgical manufacturing processes and of the quality of the products manufactured, and the development of the applications of new metallurgical products.

For carrying out its work, the Centre had at its disposal originally and up till 1960, two autonomous research sections, one situated in Liège and the other in Charleroi. In March 1960 these were merged to increase the output of the working units at the Centre's disposal and to co-ordinate still further the joint research effort of the affiliated works and companies.

Besides Belgian works, the iron-smelting works of the Grand Duchy support the Centre, as does also the Dutch iron smelting company, the Koninklijke Nederlandsche Hoogovens en Staalfabrieken, of Ijmuiden. Although the greater part of the affiliated companies are concerned with iron smelting, there is a large participation by the primary non-ferrous metal producers and fabricators' works.

On the whole, the organization of the C.N.R.M. is similar to that of the foreign research centres. Thus there are, in fact, on the one hand specialists working in well-equipped research laboratories and, on the other committees of engineers making corporate and technical studies.

However, its organization is characterized by the fact that it is based essentially, for its research in laboratories, on a close collaboration with the universities and the affiliated industrial companies and, for the undertaking of its technical research, on a still more close collaboration with the works and the specialists belonging to them.

The staff of the Centre (not including those attached to the low shaft blast furnace project mentioned later) consists at present of 200 people, 45 of them having university diplomas.

The costs of reconstruction of the Val-Benoît Abbey, which houses the Centre's laboratories, have been fully borne by industry. In addition, in order to increase the research possibilities, it has been decided to erect a new laboratory, which will be finished in 1962, having a floor area of 7,000 m^2.

Generous aid has been forthcoming from the Institut pour l'Encouragement de la Recherche Scientifique dans l'Industries et l'Agriculture. Material support has also come from the University of Liège, which houses laboratories and supply the funds necessary for their working.

The three main divisions of the Centre are:—Physical Metallurgy and Chemistry Division; Applications Research Division, and Iron Smelting Division.

International Research

Among the international agreements concluded by the Centre during the course of the last few years, two contracts have as their object the manufacture of cast iron.

The first, signed with the Association Internationale pour les Recherches au Bas-Fourneau d'Ougrée (AIRBO), refers to research entrusted to the Centre since 1952. Originally the object was to show the working possibilities of the low shaft furnace. At present the apparatus is used as a small experimental blast furnace, as it has been possible to establish a relationship in the working mechanism of the blast furnace and of the low shaft furnace.

The second, concluded with the Communauté Européenne du Charbon et de l'Acier (CECA), refers to fuel injection tests with the blast furnace with a view to reducing the consumption of coke.

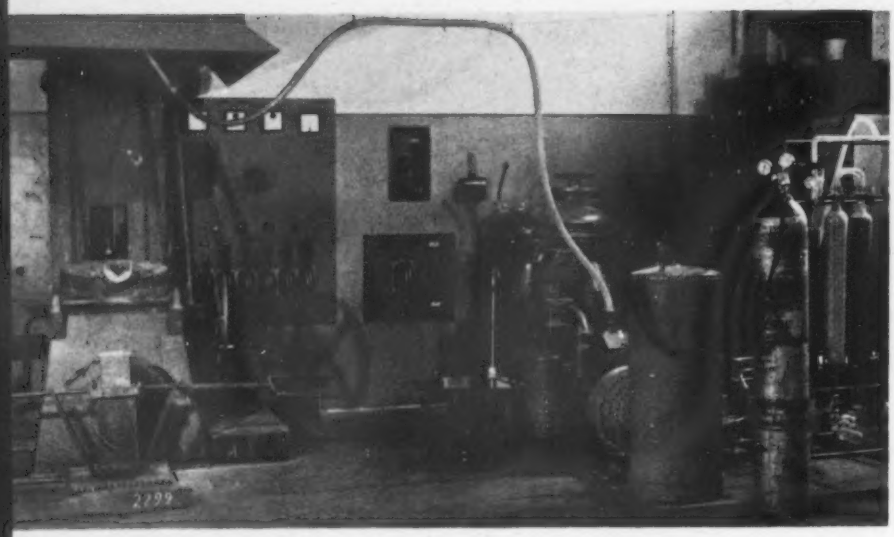
In the field of continuous casting, the Centre works in close collaboration with the British Iron and Steel Research Association (BISRA). This has resulted in the construction, at the Steel Company of Wales, of a first continuous casting line which will come into industrial operation during the year.

Finally, in a very different field, there has been participation in the production of a metallographic atlas within the framework of the CECA.

Metallurgy and Chemistry

The activity of this division stretches over several different fields, including analytical, fundamental, and physical metallurgy research. The latter is concerned with iron smelting, the applications of cobalt and the development of zinc alloys. Besides the analytical techniques mentioned below, use is made of optical and electronic metallography, the techniques of diffraction and diffusion of X-rays, the determination of mechanical properties, including the properties of creep and fatigue, the measurement of electrical resistivity, the analysis of the magnetic properties, etc.

In spite of the considerable progress made in the speed and accuracy of analytical chemistry, it is still time-consuming and costly. The possibilities of physical methods of analysis appeared promising, and for this reason the Centre interested itself in several techniques and in particular in direct spectrographic analysis and analysis by X-ray fluorescence.



Laboratory for melting and treatment of metals and alloys

The activity of one of the laboratories has been, since the origin of the Centre, concerned with the study and perfecting of spectroscopes for the control of production.

When the content of the elements to be measured is high, spectrochemistry is less advantageous. Fortunately, there is available another technique which has been used, in particular for the analysis of ores, slags and non-ferrous metals; that is X-ray fluorescence.

Finally, other analytical techniques have been studied with the object of adapting them to industrial problems: the analysis of gases by the chromatographic method, the analysis of gases and of inclusions in alloys, elemental analysis by flame spectrophotometry and by colorimetry.

Physical Metallurgy Research

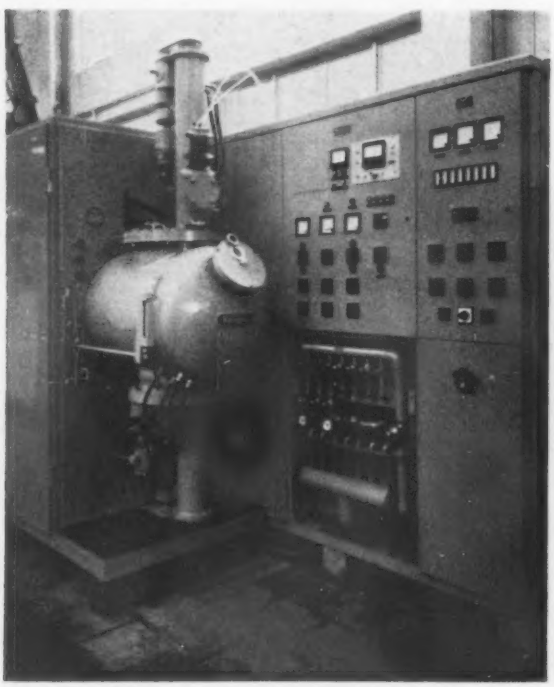
Other laboratories study the properties of rimmed steels used in the form of thin sheets. These steels are affected by ageing, that is to say that their properties, and in particular their ductility, deteriorate in the course of time, changes which are troublesome when stamping. The laboratory has systematically studied the part played by nitrogen and carbon in the ageing of steel and examined the influence of heat-treatments in atmospheres which remove nitrogen and carbon.

Qualities of special steels destined for use at high temperatures have been perfected within the framework of the work of the Committee for the Study of the Creep of Metals at High Temperatures. Some improvement of mechanical strength at high temperatures has been obtained, thanks to a better knowledge of the microstructures of these steels. It has been possible to define the most favourable microstructure: a structure containing carbides finely dispersed. The addition of several alloying elements in controlled quantities makes it possible to slow up the evolution and the coalescence of these carbides during a prolonged soaking at high temperatures.

Work has been done in particular on a steel with 1 per cent of chromium and 0·5 per cent of molybdenum, improved by additions of vanadium (0·4 per cent) and of tungsten (0·5 per cent). This steel is intended for the manufacture of heavy section steam pipes and of tubes for superheaters.

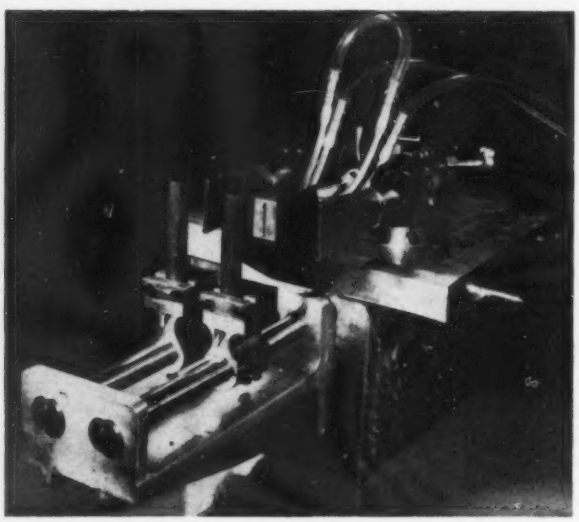
Another important advance has been obtained in steel (9 per cent chromium-1·8 per cent molybdenum-2 per cent cobalt-0·4 per cent vanadium-0·4 per cent niobium) for superheater tubes. The heat-resisting properties of this steel are higher than those of the steels currently used for this application; it is, in addition, quite ductile and malleable.

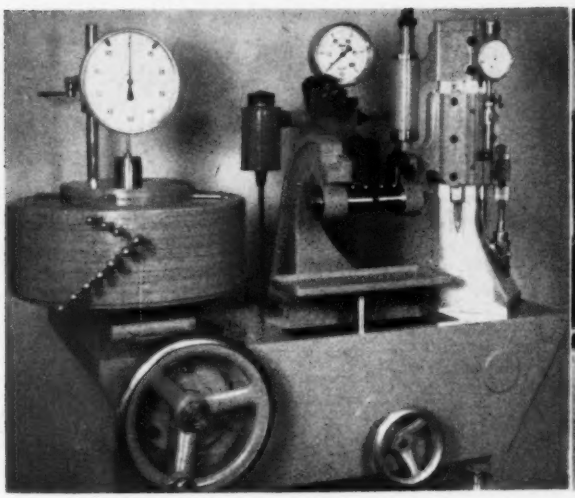
The research programme also includes the study of new alloys with 12 per cent of chromium for superheater tubes (0·1 to 0·15 per cent of carbon) and for bolts and discs of turbines (0·2 to 0·3 per cent of carbon). Finally, having regard to the equipment of



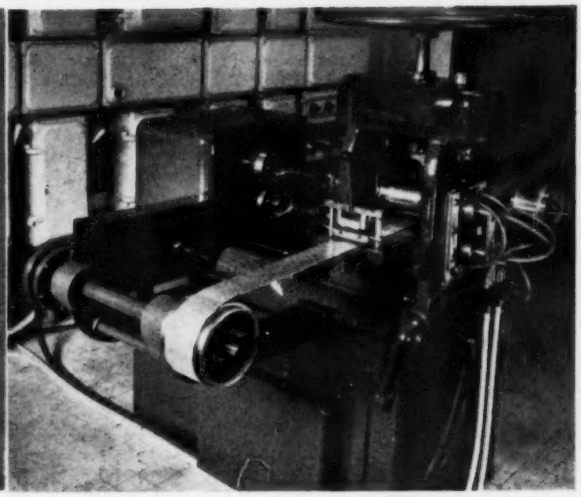
Left—Electron beam melting furnace for the preparation of high-purity alloys

Below—Apparatus for thermal shock testing





Machine for carrying out shear tests



Experimental rolling mill

steam generating stations working at ever higher temperatures and pressures with a view to improving their output, austenitic steels are also the subject of research to improve their forging and welding properties. Research of a technological nature is also carried out, such as the quantitative study of the phenomena of oxidation and of corrosion at high temperature in various atmospheres (combustion fumes of coal, oil, and superheated steam, with and without pressure), the study of the phenomena of relaxation at high temperature, etc.

Cobalt Research

In quite a different field, the C.N.R.M. has been entrusted by the Centre d'Information du Cobalt to carry out a vast programme of research designed to promote the applications of this metal.

In this field a series of investigations is being carried out with a view to determining the properties of the super-alloys. The alloys which are at present finding great outlets are those with a cobalt or nickel base. The good properties of nickel-base alloys are partly due to the existence, within the metal, of intermetallic compounds, that is to say, of stable groupings of atoms of several metallic elements, whereas those of the cobalt-base alloys are due to the presence of carbides.

The formation in these last alloys of intermetallic compounds would make it possible to increase the range of the temperatures at which they could be used. For the solution of this problem, binary and ternary metal systems likely to form such compounds are being studied. This study makes it possible on the one hand to specify the ranges of stability of the various metallic phases in relation to the temperature, and on the other hand to define the conditions of their appearance in relation to the heat-treatments and conditions of service. To this end, the alloys of cobalt-chrome-iron-carbon, cobalt-chrome-molybdenum, cobalt-chrome-tungsten have been studied. It has thus been possible to propose compositions likely to furnish new alloys.

Mechanical and chemical properties at high temperatures, and the transformations of the metallic phases encountered in alloys depend not only on their structure but also on other general properties. Among these, atomic diffusion plays an important part. In fact, at these temperatures, thermal agitation leads to an appreciable mobility of the atoms. It seems that cobalt exerts a retarding influence on the diffusion of certain elements in a metal, this being partly responsible for the good performance of super-alloys or steels in rapid cutting tools. Fundamental research carried out in the Centre's laboratories shows by direct diffusion tests this action of cobalt and establishes its characteristics. A knowledge of these phenomena and also of their conditions is essential for the understanding of the behaviour of alloys which have to be used at high temperatures.

Recent research has shown that for certain compositions rich in cobalt the properties of tool steels could still be improved by the formation of stable intermetallic compounds at temperatures higher than the carbides. Various compositions are being studied systematically to determine the influence of cobalt on the formation and stability at high temperatures of these intermetallic compounds.

In another research group, the influence of the composition or of manufacturing factors on the properties of alloys in general use is being investigated so as to find new applications. Thus, up to the present cobalt has been little used in stainless steels chiefly because of its high price and scarcity. However, now that its supply is ensured and its price has fallen considerably, the application of cobalt in this class of steel has become probable.

Particular attention is being paid to heat-resisting stainless steels combining the high corrosion and oxidation resistance of 17 per cent chromium with the good mechanical properties of martensitic steels containing 13 per cent chromium. It has been shown that cobalt makes possible an easier control of the microstructure and an increase of the mechanical properties by the accentuation of structural hardening. These steels, therefore, have improved properties and consequently wider application. These are, in particular, the martensitic steels with 18 per cent chromium of the type "431", as well as steels with high resistance and structural hardening of the type 17-7PH, 17-4PH.

Numerous alloys for permanent magnets containing cobalt have been perfected.

Present tendencies are towards the improvement of their properties by the modification of working processes and heat-treatment. Thus, work is being carried out with the object of showing the influence of the working method (melting under a vacuum, melting by electron bombardment) on the magnetic properties of magnets of the types Alnico and Ticonal XX. Already, preliminary tests make it possible to foresee not only a notable increase of the magnetic properties, but also of the forming properties. It seems possible, in fact, by these processes to obtain machinable alloys, sometimes even forgeable.

Studies are also being carried out on the possibilities of the addition of cobalt to the new metals. Thus, in titanium alloys, cobalt has proved a useful addition element, making possible after suitable heat-treatments the

obtaining of improved mechanical properties, cold and hot.

Collaboration between the laboratory and industry has resulted in the perfecting on an industrial scale of the hot rolling of cobalt alloys. Tests have also been carried out to promote the applications of an alloy with 50 per cent cobalt-30 per cent chrome-20 per cent iron and designated as UMCo-50 by the Union Minière du Haut Katanga which manufactured and used it for the first time. The various properties of mechanical resistance, cold and hot, resistance to corrosion and to oxidation, resistance to abrasion, to thermal shock, as well as the properties of hot shaping—such as rolling—were determined in the laboratory for this alloy. In addition, tests on an industrial scale have shown the behaviour of the alloy cast under working conditions.

Much other work has also been done in very varied fields—deposits on refractory metals, chemical cobalting, influence of cobalt in weakly alloyed steels, etc.

Zinc Alloys

Besides this work, the Division has undertaken studies of the physical metallurgy of zinc and its alloys, particularly the development of new alloys. The application of the rules of Hume-Rothery and of Laves has made it possible to select metals which it seems interesting to alloy with zinc.

The study of the alloys zinc-copper-titanium and zinc-copper-titanium-manganese-chromium has been undertaken. Their manufacture, rolling and mechanical properties have been examined and it has been confirmed that the incorporation of copper with zinc greatly increases its breaking load, while the incorporation of titanium gives it an increased resistance to creep.

From the theoretical point of view, the zinc corner in the ternary diagram zinc-copper-titanium has been studied and new metallographic techniques for zinc have been developed.

Fundamental research having as its object basic problems, the mechanism of precipitation in alloys and the mechanism of brittle fracture in steels, has also been undertaken. The problem relating to the mechanism of precipitation in alloys has been studied chiefly according to the techniques of internal friction and the abnormal diffusion of X-rays.

Applications Research

By specializing in the various techniques of working metals, engineers and research workers of this department study the relations between the physical properties of the metal and the requirements of their use, a programme requiring very close collaboration between the metallurgists and the users themselves.

Among the problems thus discussed, one of the most important, which concerns at the same time the Metallic Construction Sector, the Naval Construction Sector and the Heavy Iron-Smelting Sector, is the problem of the specification of strong sheets and sections for welded constructions.

The development of welded construction has introduced new problems, and in particular a new definition of "weldability of steels". As for the other properties, these are a compromise between the quality of the basic metal, the quality of the weld and the design of the assembly, which together determine behaviour in service.

At the present time, after ten years of fundamental research, steels intended for this use are now selected on the basis of much more suitable criteria than before, and constructors, on the other hand, have acquired a better knowledge of the working conditions of the material they are using and of the way to get the best out of it, both by precautions when welding and by a rationalization of the assemblies.

Among the examples which can be quoted, the most spectacular, if not the most recent, is that of the framework of the Atomium.

Iron-Smelting Division

This division, supported by a statistical and mechanographical study department for analysing the industrial results and a physico-chemical research department, deals with numerous investigations covering preparation of ores, blast furnaces, steel works, and rolling mills.

The Belgo-Luxembourg economic union produces 95 per cent of converter steel from Lorraine and Luxembourg ore by the Thomas process. The classical Thomas steel is perfectly suitable for numerous applications, such as reinforcement for concrete and free-machining steels. It even possesses properties which are especially suited for certain applications in structural engineering: rails, hardened wires for springs, etc. On the other hand, for other applications requiring a high degree of ductility when cold (thin sheets, wires, etc.) it does not stand up very well to the deformations to which it is subjected. This defect results from its higher content of nitrogen and phosphorus, and it is with a view to lowering simultaneously the level of these elements that numerous steel-makers have sought for new processes of manufacture.

In close collaboration with the affiliated works, the C.N.R.M. has been able to develop new forms of manufacture based on the one hand on the enrichment of the blast air with oxygen and, on the other hand, on the use of mixtures of oxygen and steam. Thus, it has been possible to obtain qualities of steel which have considerably enlarged the field of application of steels produced in the converter. For steels requiring high ductility when cold—for deep drawing, for example—the new qualities have been officially recognized as equivalent to the steels manufactured by the Siemens-Martin process.

The results obtained, being the average values of tens of thousands of castings, are shown in Table I.

Whilst these developments were on hand at the C.N.R.M., Austrian experts were developing a new steel manufacturing process with the converter, which was called the L.D. process (Linz-Donawitz) and which is applied to the treatment of non-phosphorus melts. This consists in principle of a refining of the melt by means of pure oxygen blown by a nozzle downwards through the molten metal. This method of blowing is, therefore, the opposite of that which is used for the Thomas process, in which the injection of air, enriched air or gaseous mixtures is upwards through the molten bath.

Belgian specialists have tried to apply the L.D. blowing method in the case of phosphorus melts. Thanks to a very close collaboration with iron-smelting circles in the Grand Duchy, a new manufacturing formula was proposed and perfected in a steelworks in the Grand Duchy.

In this process, technically pure oxygen containing pulverized lime in suspension is injected into the metal bath through a nozzle in the upper part of the converter.

Seeing that in the first approximation the new process is rather similar to the L.D. process, the Centre and the Austrian works which own the L.D. process decided to unite their efforts. To show this collaboration better, it was also decided to designate the new process by the letters LC-AC (A=Arbed, C=C.N.R.M.).

TABLE I—IMPROVED THOMAS PROCESS STEEL

Method of blast of Thomas Steel	Nitrogen per cent	Phosphorus per cent
Atmospheric air	0·0105	0·045
Air enriched with oxygen*		
formula 1	0·0080	0·045
formula 2	0·0050	0·025
Oxygen, steam and double slag	0·0025	0·025

* *Depending on cooling agent used (shot, limestone flux, ores, etc.).*

Industrial News

Home and Overseas

Import Duties

Notice has been given by the Board of Trade that they are considering an application for the exemption from import duty of the following items:—

(1) Electrolytic manganese metal of a purity not less than 99·5 per cent.

(2) Manganese nitride containing not less than 4 per cent by weight of nitrogen in all.

A statement of the applicants' case will be made available to all interested parties who wish to make representations in the matter, if they are prepared to give an undertaking to treat the information contained therein as strictly confidential and to allow their comments to be passed to the applicants for reply. Requests for a statement of the case, together with an undertaking in the terms set out above, should be addressed in writing to the Board of Trade, Tariff and Import Policy Division, Horse Guards Avenue, London, S.W.1, not later than Wednesday, October 18, 1961.

Comments from interested parties who have seen the statement of the case should be sent to the same address by Wednesday, October 25, 1961.

News from Scotland

A new brass foundry is proposed by **Lawson, Turnbull and Co. Ltd.** at 7 Willowdale Place, Aberdeen, which the company recently acquired from G.E.C. Ltd. It is also planned to locate a new brass finishing shop on the site. These developments follow the appointment of this 80-year-old plumbers' merchants and pipemaking company as main north-east distributors for the G.E.C. in certain sections of their electrical distribution. The appointment will permit re-allocation of space, including the new brass foundry and brass finishing plant planned for Willowdale.

Fighting Corrosion

At an exhibition held at Londonderry House, London, this week, **Henry Wiggin and Company Ltd.** illustrated the properties and uses of Wiggin corrosion-resisting alloys. It was the natural successor to the exhibition of Wiggin heat-resisting alloys, "When It's Really Hot", shown with great success in London and the provinces during 1959-60. The exhibition described the different types of corrosion, how they arose, and gave information on factors affecting corrosion and the resistance of Wiggin materials to the more common corrosive substances.

It also displayed examples of the successful use of these materials in corrosive conditions, and was supported by technical publications, film shows and lectures.

Electric Billet Heaters

To replace three oil-fired furnaces, the Austin Motor Company Limited have installed, at the Longbridge works, a G.W.B. two-tunnel induction heater for the forging of manganese-molybdenum steel billets. This new furnace, specially designed by G.W.B. Furnaces Ltd., is stated to do twice the work of three conventional type furnaces. Connecting rods for B.M.C. engines are finally produced from the billets.

The new furnace, illustrated on this page, is capable of heating up to a temperature of 1,250° C. and is wholly engaged in the heating of En.16 steel billets measuring $1\frac{3}{8}$ in. square by $8\frac{3}{8}$ in. long and $1\frac{1}{2}$ in. square by $7\frac{3}{8}$ in. long, each billet making a pair of con rods. Dependent upon which size of billet is being heated, the larger weighs 6·5 lb., the smaller 4·8 lb. approximately, they can be discharged from each coil at the rate of one every 13-14 sec. Pneumatic interlocked pushers operate on a preset time cycle and load one billet into each of the two coils alternately to give a workpiece discharge of one billet per 6·5-7 sec. from both coils.

After heating to the required temperature, the billets then fall on to an inclined chute, which delivers them to the bed of a Wilkins and Mitchell reducing roll. After three rolling operations, the billets are hand fed into a Hasenclever forging press, where they are flattened, moulded and finished. Finally, they are clipped on a Wilkins and Mitchell clipping press. The coils, which are the hearts of the furnace, are formed from high conductivity water-cooled conductors. Each coil is 58 in. long. Electrically, the billet heater is arranged as two independent units, and can be run as a single-tunnel equipment if required. The control panel, and similarly the power equipments, are arranged in the form of two separate sets.

West German Production

According to the Office for Industry at Frankfurt, West Germany's production of pig aluminium in August amounted to 15,118 tons (provisional) against 14,874 tons in July. Production of pure aluminium was 1,471 tons (provisional) against 1,585 tons in July, and of aluminium alloys 9,118 tons (provisional) against 9,052 tons.

Refined copper produced by the smelters amounted to 19,787 tons (provisional) against 20,246 tons in July; that produced by refineries to 5,294 tons (provisional) against 6,466 tons in July, and copper alloys produced totalled 3,157 tons (provisional) against 3,470 tons previously.

Semi-manufactures of aluminium and aluminium alloys made in August totalled 19,851 tons (provisional) against 18,890 tons in July, and of copper and copper alloys 52,116 tons (provisional) against 53,383 tons previously.

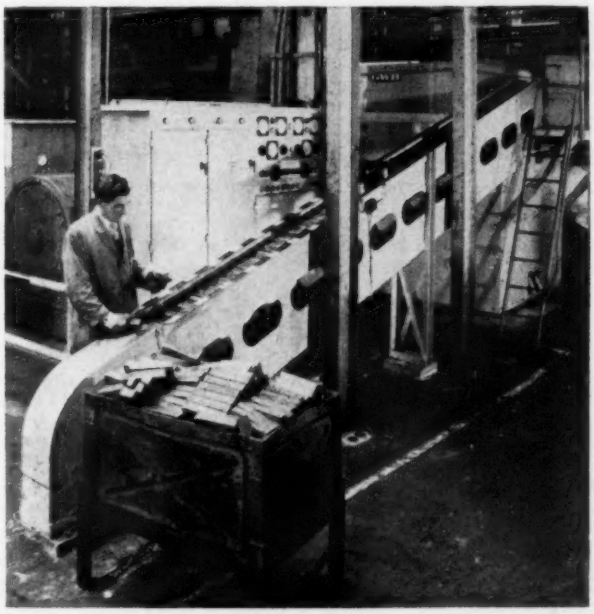
A Removal

A member of the Firth Cleveland group, **Simmonds Aerocessories Limited** have now moved their Birmingham Midland area sales office. This move, from Lancaster House, Newhall Street, to new and larger office accommodation at Herbert House, Cornwall Street, caters for continuing expansion and increased staffing requirements. The existing Telex numbers 33-312 and Birmingham Central 2248-9 telephone numbers have been retained, and a third telephone line, Birmingham Central 2719, has been added.

Simmonds products for the Midland area are marketed under the direction of Mr. A. H. Patterson, Midland area manager for the Nut and Bolt Sales Division, and Mr. K. E. Amos, assistant sales manager for the Spire Speed Nut Division.

Visiting U.S.A.

Assistant director of the **Tin Research Institute,** Mr. W. R. Lewis has left on a visit to the United States and Canada, where he will attend the American Metals Show at Detroit, where the Tin Research



General view of G.W.B. billet heater for preheating by induction manganese-molybdenum steel billets

Institute Inc. is exhibiting. He will be meeting American chemical manufacturers to discuss British and European progress in organic tin chemistry in conjunction with the Institute.

He will also visit Montreal and Toronto before returning to the United Kingdom at the end of this month.

Power Press Equipment

New facilities for the manufacture of power presses and associated equipment have been completed at the Scotswood works of **Vickers-Armstrongs (Engineers) Ltd.** The new Power Press Division has been formed to satisfy the increasing demand for presses designed by the Clearing Division of **U.S. Industries Inc.**, manufactured by the Vickers company and sold in this country under the name British Clearing by **Rockwell Machine Tool Company Ltd.** The division also manufactures associated equipment, including Vickers-McKay metal-processing equipment

Work formerly carried out at two different plants has been consolidated into one, and a considerable investment in new plant and equipment has been made by Vickers in order to increase productive ability and efficiency. The division occupies about 22 acres, and the works are equipped to fabricate up to 12 in. thickness of plate and have produced welded structures up to 100 tons in weight. The machine shops handle complete processing of the great variety of components required for products, from the smallest turned pins to the massive fabrications which are faced, milled and bored on large horizontal borers.

The illustration on this page shows a fully-enclosed Clearing single-action four-point suspension press, capacity 300 tons, bed area 84 in. right to left and 72 in. front to back.

Retirement Presentations

On a recent occasion, Sir Douglas Branson, K.B.E., chairman of **Walker and Hall Limited,** of Sheffield, presided over a dinner in the staff canteen when two senior members of the company received gifts on their retirement after many years' service.

Mr. H. E. Marshall retired at the age of 72 from the position of cashier after serving with the company since October 1902. He was presented with a gold watch from the company and a "Pride" tea set from the staff.

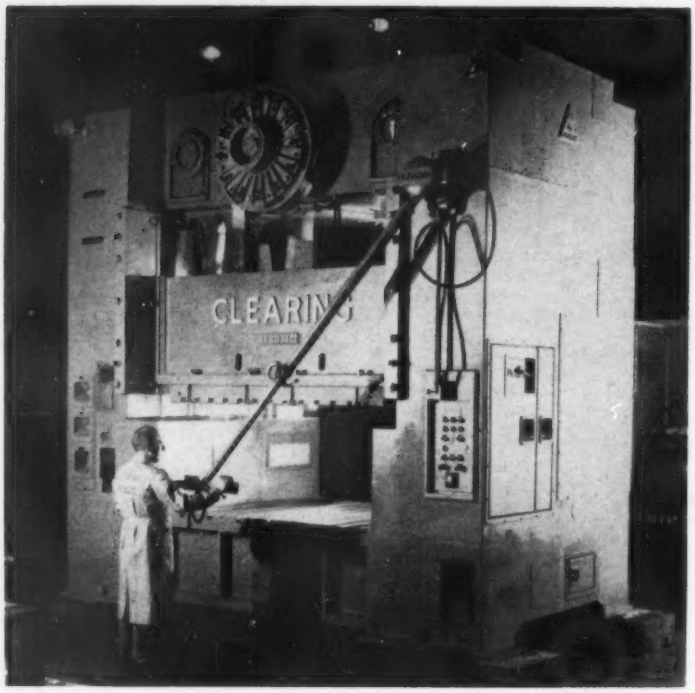
Mr. G. H. Howe, aged 67, joined the company at the end of 1919 and was appointed case department manager in 1936. He received a cheque from the company and an infra red heater and electric toaster from the staff.

Oil-Fired Heaters

Four new economy-plus heaters will be displayed by **Gloster Equipment Ltd.** at the International Factory Equipment Exhibition, to be held at Earls Court, London, next month. These oil-fired flued heaters are available with built-in tanks, or available for gravity feed from outside tanks.

The Gloster 62150 has been designed as a workshop heater, with a maximum heating capacity of 60,000 B.Th.U/hr. This is a robust, efficient heating unit, ideal for use in factory or garage.

Gloster's three other space heaters on display are suitable for office, factory or domestic use. The Gloster 6350 heater has a maximum output of 20,000 B.Th.U/hr., with fuel consumption—depending on the heat required—varying between 7 and 28 hr. to the gallon. Gloster 6535 is a smaller heater but with an impressive heat output — from 4,000 to 14,000 B.Th.U/hr. Space heater VZH/35 completes the range of Gloster products on display. This is a neat and compact unit with a heat output from 4,000 to 14,000 B.Th.U/hr.



A fully-enclosed Clearing single action 4-point suspension press, capacity 300 tons

Aluminium Beer Casks

Beer casks made by **Grundy (Teddington) Ltd.** are constructed from aluminium-silicon-magnesium alloy (H30) sheet and extrusions, fully heat-treated after manufacture, the sheet being 12 gauge clad on one side with about 10 per cent of this thickness with aluminium of 99·8 per cent purity supplied by **The British Aluminium Company Ltd.** Use of this clad sheet ensures maximum resistance of the interior surface of the cask to any possible attack by the contents.

The "Grundycask" is fabricated by argon arc welding, and the joints, being fused, are dense and smooth, both outside and in, thus guarding against leaks under pressure and against any roughness on the interior surface which might provide lodgement for contaminating matter. A practical aspect of the aluminium cask is its light weight, a characteristic attained by virtue of the metal and without sacrifice of robustness. The 9 gal. Grundycask weighs only 21 lb., while the 18 gal. size weighs 34 lb., these figures being less than half the weight of comparable wooden or stainless steel casks.

It was in 1956 that Grundy began to develop fabricated aluminium barrels for storing beer, the first produced in Britain. At the present time several breweries have had these under test and have now placed production orders with the company. About 2,000 barrels a week are being produced in 9, 10, 11 and 18 gallon sizes, and the company has facilities planned for the production of 5,000 a week. Also in preparation is a 36 gallon cask, which should be in production before the end of this year.

Forthcoming Meetings

October 15—Institute of Metal Finishing. South-west Branch. Royal Hotel, Gloucester. "Jig Design and Manufacture." J. Preston. 7.30 p.m.

October 16—Institute of Metals. Assembly Hall, The Royal Commonwealth Society, Craven Street, London, W.C.2. Three-day Conference on the Metallurgy of Beryllium.

October 16—Institute of Metal Finishing. London Branch. Northampton College of Technology, St. John Street, London, E.C.1. "Chromate Passivation of Brass." S. G. Clark. 6.15 p.m.

October 18—Institution of Production Engineers. Wolverhampton Graduate Section. College of Technology, Wulfruna Street, Wolverhampton. "Shell Moulding and its Recent Developments." A. D. Lewis. 7.15 p.m.

Electric Furnaces

We are informed by **Alan Worswick (Engineering) Ltd.** that they have concluded an agreement with Russ-Elektroofen K.G., of Cologne, Western Germany, and have been appointed sole agents for the sale of the Russ-Electric furnaces. The products of the German firm comprise a wide range of induction and resistance-heated furnaces of all types

for both the ferrous and non-ferrous industries.

A useful catalogue of these furnaces, with details and illustrations, is being distributed from which some idea may be obtained of the range of equipment provided for the non-ferrous metals industry. These include low frequency channel-type induction melting furnaces, mains frequency coreless induction furnaces, double-hearth low frequency induction furnaces, mains frequency induction heaters for billets and slabs, resistance heated hearth-type melting furnaces, resistance heated crucible-type melting furnaces, resistance heated crucible-type ladling furnaces, crucible-type refining furnaces for aluminium alloys, heating furnaces for slabs and extrusion billets, with and without forced air circulation, intermediate annealing and heat-treating furnaces, solution heat-treating and ageing furnaces, with and without forced air circulation, designed as box, pit or continuous furnaces.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week fell 229 tons to 5,009 tons, comprising London 1,982, Liverpool 1,538 and Hull 1,489 tons.

Copper stocks fell 2,084 tons to 20,510 tons, distributed as follows: London 450, Liverpool 16,010, Birmingham 50, Manchester 3,925, Hull 50, and Glasgow 25 tons.

Lead duty-free stocks rose 180 tons to 7,207 tons, comprising London 6,857, Glasgow 200 and Swansea 150 tons. In-bond stocks remained at 3,602 tons, all supplies in London.

Zinc duty-free stocks rose 1,230 tons to 5,274 tons, comprising London 2,613, Glasgow 36, Hull 470, Manchester 300, Liverpool 55, and Avonmouth 1,800 tons. In-bond stocks fell 50 tons to 3,103, all supplies in London.

Specialized Lubricants

A new addition to their range of cutting lubricants has been announced by **Rocol Limited**. Rocol "R.T.D. Spray" is an aerosol form of Rocol R.T.D. compound, which is already known as an extremely efficient cutting lubricant, originally introduced for reaming, tapping and drilling and now used extensively for difficult operations on all materials. The development of R.T.D. Spray enables R.T.D. Compound to be applied "at the touch of a button", a unique method for this type of lubricant.

Full details of this lubricant are given in Publication No. 21, which also contains a selection of reports obtained during development trials which show clearly the outstanding effectiveness of the product.

Forthcoming Event

A conference on "Diffusion and Mass Transport in Solids" has been arranged by the **Institute of Physics and the Physical Society** to take place next year on April 10 and 11. This conference will be held at Reading University and it is provisionally proposed to hold sessions on general theoretical aspects of diffusion in solids, and on diffusion and related mass transfer phenomena in metals, in oxides and covalent materials, and in strongly ionic solids.

The conference will be residential and the numbers will be limited. Further particulars and application forms will be available in January 1962 from the Administration Assistant to the Institute and Society at 47 Belgrave Square, London, S.W.1.

Lead Cable Sheathing

A new publication has been issued by the **Lead Development Association** under the title of "Lead Cable Sheathing—Alloy Characteristics and Applications". This is the second publication in the series issued by the Association designed to stimulate interest in the use of lead in cable sheathing.

Industrial Gas Equipment

What is stated to be the largest collection of gas-fired industrial installations ever housed under one roof in the North-West will be exhibited by the North Western Gas Board at the City Hall, Manchester, from Tuesday next, October 17, until October 26 as a special section of the Industrial Equipment Exhibition. It will occupy the whole of the Byrom Hall and will be designed to present a broad glimpse of the manifold industrial activities in which town gas plays a key part.

No less than forty-one industrial firms from all over the United Kingdom have lent gas-fired equipment for the exhibit and their installations will be presented in nine different sections, namely: (1) Heat-treatment of metals; (2) metal melting; (3) hot working of metals; (4) glass working; (5) burners; (6) product finishing; (7) space heating; (8) textiles; (9) food.

In addition, a special section will present the work the gas industry in the North West, supported by the Gas Council's two research stations at Fulham and Solihull, is doing to develop special gas-fired appliances for new industrial processes.

Aluminium for Fairgrounds

Increasing use is being made of aluminium for fairground equipment, as its light weight eases transport problems and simplifies the handling of large fabricated sections on site. Furthermore, aluminium has a longer life than materials previously used, and as it does not corrode or decay, maintenance attention is greatly reduced.

LIGHT METALS STATISTICS IN JAPAN (June 1961)

Classification	Production	Shipment	Stock	Export
Alumina	30,730	29,996	17,641	7,087
Super purity Al	85	90	692	0
Primary Al	12,904	13,309	2,607	0
Secondary Al	5,414	5,514	1,145	0
Wrought products (Al and its alloy)	14,300	13,897	5,225	974
Plate, sheet and strip	9,386	9,285	2,990	732
Foil	882	938	329	
Rolled and extruded shape	2,518	2,505	617	
Forgings	56	—	—	—
Electric wire	1,458	1,169	1,289	242
Powder, flake and paste	—	—	—	—
Casting	6,355	—	—	—
Sand and permanent mould	3,442	—	—	—
Die	2,913	—	—	—
Sheet products	2,685	2,536	1,394	115
Primary Mg	137	172	37	—
Secondary Mg	197	239	289	—
Mg casting	25	—	—	—
Sponge Ti	211	166	1,146	129
Super purity Al (July)	88	118	663	—
Primary Al (July)	13,171	12,931	2,847	0

One example of the application of aluminium for fairground equipment is the new dodgem track run by Mr. Albert Corrigan which has been operating this summer at Fleetwood Amusement Park. The arena is 64 ft. long by 40 ft. wide, and MG2 aluminium tubing and Duralumin H-WP angled members are used for the floor supports and the roof structure. For insulating purposes, the roof, which carries the mesh conductor ceiling, is mounted on wooden stanchions.

A further example is a helter skelter run by Mr. Fred Thompson. The tower stands 45 ft. high, with a maximum diameter of 25 ft., and is constructed from riveted Duralumin H-WP sections fastened together on the inside. Each section comprises an aluminium sheet fixed to a frame of aluminium-alloy angled members. The spiral track is wooden, with MG2 aluminium tubing for strength and lightness, and is supported on brackets secured to the exterior of the tower.

Both the dodgem track and the helter skelter were manufactured by the Supercar Co. (Coventry) Ltd., of Leamington Spa, who pioneered the use of aluminium for amusement equipment, from aluminium and aluminium-alloy supplied by **James Booth Aluminium Ltd.**

Murex Extensions

Extensions costing in the region of £350,000 have recently been completed at the works of **Murex Welding Processes Ltd.**, at Waltham Cross. The new buildings consist of a 500 ft. long single-storey production shop having an uninterrupted floor area of 62,000 ft² for the manufacture of electric arc welding plant and a two-storey office block of 7,200 ft² to accommodate the plant sales department, drawing office and works engineer's department.

The extensions represent a further stage in the planned development of the Murex works which, at the time of its erection in 1938, was considered to be the largest all-welded single storey factory in Europe. The new buildings are designed to provide the additional accommodation required to meet the consistently increasing demand for Murex metal arc welding electrodes and equipment, both at home and abroad.

The all-welded steel frame and roof construction of the new plant shop follow the same design as that of the original factory building, which created widespread interest by demonstrating the large uninterrupted floor areas which could be obtained by means of welded construction.

A Golf Meeting

On Wednesday of last week the autumn dinner of the **National Association of Non-Ferrous Metal Merchants Golfing Society** was held at the Midland Hotel, Birmingham, under the chairmanship of the society captain, Mr. J. E. Lisle.

The autumn meeting of the society was held the following day at Copt Heath Golf Club, at Solihull, with the following results:—Stableford competition for the Captain's Cup, won by Mr. J. C. Wolff; the runner-up was Mr. M. Doherty, and third was Mr. R. Diamond. Hidden prizes were won by Mr. L. E. Lilley and Mr. J. E. Lisle, and the Veteran's Cup was won by Mr. S. Suckling.

In the afternoon, a Greensome competition against bogey was played, with the following results: winner, Mr. R.

Deutsch, partnered by Mr. J. Wilde, and runners-up were Mr. R. Easdale, partnered by Mr. D. Stirratt.

Exports to Cuba

News from the **Suffolk Iron Foundry (1920) Ltd.** is that they have received an order from the Government of Cuba for 2½ tons of brazing rods to the value of £2,500. The same company has also received an order value £350 from Bolivia.

High Purity Metals

The latest series of data sheets issued by **Johnson, Matthey and Co. Limited** covers their range of high purity metals. In recent years, the rapid advance of technical developments in many fields has brought about a demand for a wider variety of high purity metals and a greater diversity of physical forms. Johnson Matthey have investigated and perfected techniques for producing an extensive range of high purity metals and for fabricating many of them into rod, sheet and other forms.

In the data sheets, information is given on 38 metals, including noble, rare earth, and certain base and rarer metals. The general properties of each element are tabulated, and details are given of the forms of current production. In most cases the metals are available in more than one grade, the metallic impurity contents being expressed in parts per million.

Rolling Mill Contract

At present, a continuous billet mill and a continuous rod mill, including all ancillary equipment, are being built by **Schloemann Aktiengesellschaft,** Düsseldorf, on behalf of Appleby-Frodingham Steel Co. Ltd., in Scunthorpe. Both plants are scheduled to commence production in 1962. The four-stand billet mill with advance two-high reversing stand will be chiefly used for preparation of the starting material required for the rod mill; besides, it is also earmarked for the manufacture of semi-products for direct resale. The rod mill is designed to handle a diameter range of from $\frac{7}{32}$ in. to 1¼ in. at a monthly output of up to 30,000 tons. The unit provides for four-strand rolling in the roughing train, and two-strand operation in both intermediate trains, as well as the finishing trains.

News from Birmingham

The pattern of industry in the Midland area shows little change. There is a moderate demand for new metal in the consuming industries, but forward buying is on a limited scale. The slight drop in the Bank Rate is a trend in the right direction, but not enough to make any real difference to the economic situation. Makers of machine tools have good order books for the last quarter, and the building trade is still enjoying a boom. The motor trade is suffering from the usual autumn lull, and the export markets are less active than they were a year ago.

Orders for special steels and alloys constitute a bright patch in an otherwise dull market. A big tonnage of constructional steel is being used in rebuilding projects in towns and cities all over the country. Makers of heavy forgings also have a fair amount of work. The re-rolling mills are working below capacity. Plenty of semi-finished steel is available for early delivery. In the foundries, there are substantial orders for heavy castings for engineering purposes, but the light castings industry is rather quiet.

MEN and Metals

It has been announced that **Cmdr. Alan B. Dickie** and **Mr. Frederick H. Stimson** have been appointed assistant directors of Newman Hender and Company Limited.

We learn that **Mr. P. A. Cartwright** has left Wilmot Breeden Limited to take up an appointment as head of the work study and operational research department of The Round Oak Steel Company, of Brierley Hill, Staffs.

Five new members of the Council for Scientific and Industrial Research have been appointed by **Lord Hailsham,** the Minister for Science. They are as follows:—**Mr. L. H. Bedford,** C.B.E., M.A., B.Sc., F.R.Ae.S. (director of engineering, Guided Weapons Division, English Electric Aviation Limited); **Mr. G. B. R. Feilden,** M.A., M.I.Mech.E., F.R.S. (managing director, Hawker Siddeley Brush Turbines Limited); **Professor E. R. H. Jones,** D.Sc., F.R.I.C., F.R.S. (Waynflete Professor of Chemistry, Oxford University); **Professor O. A. Saunders,** D. Sc., M. I. Mech. E., F.R.Ae.S., F.R.S. (Professor of Mechanical Engineering, Imperial College, London), and **Mr. H. C. Tett,** B.Sc., A.R.C.S., A.M.I.Mech.E. (chairman and managing director, Esso Petroleum Company Limited).

In addition to the above, the present constitution of the D.S.I.R. Research Council is as follows: **Sir Harold Roxbee Cox** (chairman), **Professor B. Bleaney, Professor C. F. Carter, Dr. J. W. Cook, Mr. Frank Cousins, Sir Walter Drummond, Vice-Admiral Sir Frank Mason, Dr. C. J. Smithells** and **Mr. Lewis T. Wright,** with **Sir Harry Melville** as secretary.

Two board appointments in the steel division of the B.S.A. group of companies have been announced, both on the sales side. **Mr. A. H. Mills,** A.M.I.Mech.E., joins the board of Jessop-Saville (Small Tools) Limited and becomes sales director, and **Mr. F. A. Lytton,** B.Sc., has been appointed to the local board of Jessop-Saville Limited, Sheffield, as export sales director.

Whilst continuing as executive chairman, **Sir Ivan A. R. Stedeford,** G.B.E., has relinquished the managing directorship of Tube Investments Limited. **Sir William Strath,** K.C.B., **Mr. W. Hackett, Junr.,** and **Mr. R. D. Young** have been appointed managing directors of the group.

Joining the company in 1938 as a salesman in the steel department, **Mr. H. Stewart** has been appointed to the board of Cox and Danks, a company in the Metal Industries group.

It has been announced that **Mr. J. A. W. Gill** has been appointed a director of Steele and Cowlishaw, a member of the Baker Perkins group.

Appointed general sales manager to Aerostyle Limited, **Mr. Edgar Crisp** has been with the company for some 35 years and, from starting as a warehouse assistant has, during the years, passed through the various departments of the company. For the past six years Mr. Crisp has been handling sales of the whole range of equipment manufactured by the firm, and in his new appointment will control the activities of the representatives of the company covering England, Scotland and Wales.

Assistant research manager, Metals Division, Imperial Chemical Industries Limited, **Dr. W. O. Alexander,** F.I.M.,

has been appointed technical director of Foseco International Limited with effect from January 1, 1962.

We are informed that **Mr. E. E. Bishop** has been appointed laboratory manager to Wilmot Breeden Limited.

News from Kaiser Aluminium and Chemical Corporation is to the effect that **Mr. Ford. R. Morrow** has been appointed manager of the New York office of the Corporation's International Division.

It has been announced that **Mr. J. B. Simpson,** A.C.S.M., M.I.M.M., M.I.Min.E., has been elected President of the Institution of Mining and Metallurgy for the year 1962-63. He will take office in May 1962 in succession to **Mr. A. R. O. Williams,** O.B.E., A.R.S.M., B.Sc. Mr. Simpson is mining consultant to the Anglo-French Exploration Company Limited.

Export sales manager of the Evode group of companies, **Mr. S. B. Knowlden** is visiting East, West and Central Africa during this month and November as part of the company's intensification of their export drive.

It is learned from the Plessey Company Limited that **Mr. A. A. Evans** has been appointed sales manager of their capacitors and resistors division at Swindon. Previously, Mr. Evans was Swindon regional sales administrator.

The Council of British Manufacturers of Petroleum Equipment announce the appointment of **Mr. R. A. Pittman,** B.Com., F.C.I.S., as deputy director, a new position which the Council's increasing membership and activities has rendered necessary.

Metal Market News

JUST when it appeared that the price of cash copper would break through £220 a sharp rise occurred, and on Tuesday of last week a rally developed which eventually carried the prompt quotation up to £229 5s. 0d. According to reports, much, and perhaps all, of this advance in value was due to influential buying which persuaded bears to cover at the best prices they could obtain. At the time of writing there is little indication that consumers have abandoned their cautious attitude and unless they come in as buyers it is difficult to see how the higher level can be maintained. Supplies of copper seem still to be adequate and at the beginning of last week a further advance of 250 tons to 22,594 tons in L.M.E. stocks was reported. This is certainly the highest level reached since the reopening of the copper futures market in August 1953. Trading in standard copper was extremely active and the turnover much above average at around 26,700 tons, a total which included carries and a certain amount of Kerb business. Not unnaturally, the futures market in New York has been firm following the strong lead given by London, and consumer business in the United States appears to be on a good scale, without, however, being in any way spectacular. Comex, however, fell back on Friday.

Last week's buying on the futures market appears to have been a good deal concentrated on the cash position, the result of this being that the contango collapsed from £4 to £1 5s. 0d. This was obviously rather discouraging for those who wished to use the market for hedging, but with warehouse stocks of about 22,600 tons the premium for three months can hardly remain at this low figure. Bank Rate was reduced on October 5 to 6½ per cent, and to some extent this helped to put the price up, but the country has been warned by the Chancellor that this modest cut in the official discount rate should not be interpreted as meaning that the Government is letting up on its Little Budget policy. From the bottom, copper has now risen to £9, but by the end of last week it looked as though the so-called influential buying was not doing more than keeping the quotation steady at the higher level. Both on Thursday and Friday buying was on a big scale, but the advance in values was meagre. At the close, cash stood at £229 and three months at £230 5s. 0d., these prices showing advances of £6 and £3 15s. 0d. in the respective positions.

Trading in tin was again on an active scale, the turnover amounting to about 2,500 tons, but the tone of the market was poor and a lot of ground was lost. Sentiment seems now to be rather bearish, last week's losses of £15 in cash and £14 in forward being ascribed to uncertainty about the outcome of the Tin Council meeting coupled with fears regarding the effect of the next G.S.A. release. Consumer demand is believed to have improved and the inclination seems to be to secure metal after any setback in price. Lead made a recovery from the lowest point touched last week, and on a turnover of 4,300 tons, cash gained 10s. at £63 10s. 0d. and three months 5s. at £65. Zinc was a very disappointing market, closing above the worst but nevertheless 30s. down for cash at £72 and 20s. lower for three months at £72 15s. 0d. As we go to press, the tin market is showing a disposition to await the expected I.T.C. communique.

New York

At the week-end copper futures, after early steadiness, declined on scattered selling. Dealings were modest. In physical copper, dealers indicated steady, quiet conditions. Leading custom smelters said November demand was still light, but one major custom smelter said that export demand was good and domestic enquiry continued satisfactory. Leading producers noted reasonable demand for November copper. Scrap copper was unchanged.

Tin was softer and quiet. Spot was offered at 120½ cents/lb., October at 120⅜, November at 120¼, and December-January at 120 cents. Earlier light sales for December at 120 cents were reported. Lead was fairly active. Zinc was quiet. In the closing stage, tin was quiet and steady. Traders said interest was centred on the opening of the International Tin Council meeting this week.

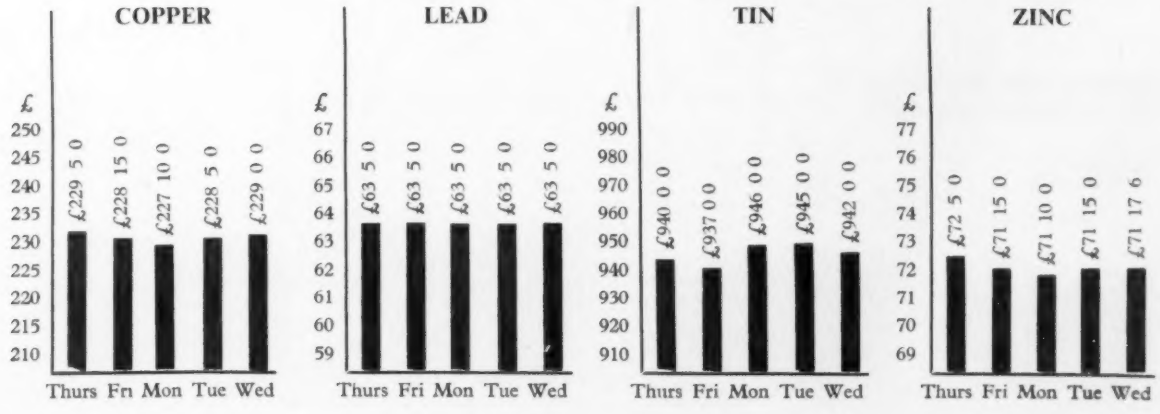
The Aluminium Association reported that net shipments of aluminum sheet and plate during August amounted to 130,547,000 lb. This compared with 120,072,000 lb. (revised) for July and 114,784,000 lb. for August 1960.

Zurich

The Swiss non-ferrous metals market was active in September, reflecting the boom in the engineering industry. Trade circles stressed, however, that, partly due to the high price level, manufacturers limited purchases to their immediate requirements. Nevertheless, prices fluctuated fairly sharply. Copper prices declined and tin prices also eased on reports of large-scale American selling, but later recovered again. A further weakening of the copper price is expected.

London Metal Exchange

Thursday 5 October to Wednesday 11 October 1961



C

NON-FERROUS

PRIMARY METALS

All prices quoted are those available at 2 p.m. 11/10/61

		£	s.	d.
Aluminium Ingots	ton	186	0	0
Antimony 99·6%	„	237	10	0
Antimony Metal 99%	„	230	0	0
Antimony Oxide				
Commercial	„	194	10	0
Antimony White Oxide	„	212	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		11	0
Calcium	„	2	0	0
Cerium 99%	„	15	0	0
Chromium	„		6	11
Cobalt	„		12	0
Columbite	per unit		8	0
Copper H.C. Electro	ton	229	0	0
Fire Refined 99·70%	„	228	0	0
Fire Refined 99·50%	„	227	0	0

		£	s.	d.
Copper Sulphate	ton	77	0	0
Germanium	grm.		—	
Gold	oz.	12	10	0½
Indium	„		10	0
Iridium	„	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	63	5	0
Magnesium Ingots	lb.			
99·8%	„		2	2½
99·9+%	„		2	3
Notched Bar	„		2	9½
Powder Grade 4	„		5	6
Alloy Ingot, AZ91X		1	11½-2	1¼
Manganese Metal	ton	280	0	0
Mercury	flask	62	0	0
Molybdenum	lb.	1	15	0
Nickel	ton	660	0	0
F. Shot	lb.		5	11
F. Ingot	„		5	11
Osmium	oz.	20	0	0
Osmiridium	„		—	

		£	s.	d.
Palladium	oz.	9	0	0
Platinum	„	30	5	0
Rhodium	„	46	0	0
Ruthenium	„	16	0	0
Selenium	lb.	2	6	6
Silicon 98%	ton	123	0	0
Silver Spot Bars	oz.		6	7¾
Tellurium Sticks	lb.	2	0	0
Tin	ton	942	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	72	7	6
Dust 95/97%	„	118	10	0
Dust 98/99%	„	124	10	0
Granulated 99+%	„	97	7	6
Granulated 99·99+%	„	109	16	3

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

All prices quoted are those available at 2 p.m. 11/10/61

Aluminium Alloy (Virgin)	£	s.	d.
B.S. 1490 L.M.5	ton		
B.S. 1490 L.M.6	„		
B.S. 1490 L.M.7	„		
B.S. 1490 L.M.8	„		
B.S. 1490 L.M.9	„		
B.S. 1490 L.M.10	„		
B.S. 1490 L.M.11	„		
B.S. 1490 L.M.12	„		
B.S. 1490 L.M.13	„		
B.S. 1490 L.M.14	„		
B.S. 1490 L.M.15	„		
B.S. 1490 L.M.16	„		
B.S. 1490 L.M.18	„		
B.S. 1490 L.M.22	„		
Aluminium Alloys (Secondary)			
B.S. 1490 L.M.1	ton	152	0 0
B.S. 1490 L.M.2	„	152	0 0
B.S. 1490 L.M.4	„	161	0 0
B.S. 1490 L.M.6	„	176	0 0
***Aluminium Bronze**			
BSS 1400 AB.1	ton	238	0 0
BSS 1400 AB.2	„	245	0 0

		£	s.	d.
***Brass**				
BSS 1400-SCB2	ton	176	0	0
SCB3	„	171	0	0
***Gunmetal**				
R.C.H. 3/4%	ton		—	
(85/5/5/5) LG2	„	212	0	0
(86/7/5/2) LG3	„	222	0	0
(88/10/2/1½) LG1½	„	283	0	0
***Manganese Bronze**				
BSS 1400 HTB1	„	194	0	0
BSS 1400 HTB2	„	213	0	0
BSS 1400 HTB3	„	228	0	0
Nickel Silver				
Casting Quality 12%	„	255	0	0
„ „ 16%	„	265	0	0
„ „ 18%	„	310	0	0
***Phosphor Bronze**				
B.S.1400P.B.1.(A.I.D. released)	„	314	0	0
B.S. 1400 L.P.B.1	„	236	0	0

**Average prices for the last week-end.*

Phosphor Copper	£	s.	d.
10%	ton	252	0 0
15%	„	255	0 0
Phosphor Tin			
5%	„	1022	0 0
Silicon Bronze			
BSS 1400-SB1	„	280	0 0
Solder, soft, BSS 219			
Grade C Tinmans	„	424	10 0
Grade D Plumbers	„	336	0 0
Grade M	„	469	0 0
Solder, Brazing, BSS 1845			
Type 8 (Granulated)	lb.		—
Type 9	„		—
Zinc Alloys			
BSS 1004 Alloy A	ton	103	6 3
BSS 1004 Alloy B	„	107	6 3
Sodium-Zinc	lb.		2 6

SCRAP METALS

Merchants' average buying prices delivered, per ton, 10/10/61

Aluminium	£
New Cuttings	134
Old Rolled	100
Segregated Turnings	72
Brass	
Cuttings	159
Rod Ends	141
Heavy Yellow	139
Light	133
Rolled	146
Collected Scrap	133
Turnings	134

Copper	£
Wire	199
Firebox, cut up	197
Heavy	196
Light	193
Cuttings	204
Turnings	189
Braziery	162
Gunmetal	
Gear Wheels	197
Admiralty	197
Commercial	178
Turnings	173

Lead	£
Scrap	53
Nickel	
Cuttings	—
Anodes	590
Phosphor Bronze	
Scrap	178
Turnings	173
Zinc	
Remelted	66
Cuttings	55
Old Zinc	35

METAL PRICES

SEMI-FABRICATED PRODUCTS

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products

		£ s. d.
Aluminium		
Sheet 10 S.W.G.	lb.	2 10½
Sheet 18 S.W.G.	„	3 0½
Sheet 24 S.W.G.	„	3 3½
Strip 10 S.W.G.	„	2 10½
Strip 18 S.W.G.	„	2 11½
Strip 24 S.W.G.	„	3 1
Circles 22 S.W.G.	„	3 4½
Circles 18 S.W.G.	„	3 3½
Circles 12 S.W.G.	„	3 2½
Plate as rolled	„	2 10
Sections	„	3 4
Wire 10 S.W.G.	„	3 1½
Tubes 1 in. o.d. 16 S.W.G.	„	4 4
Aluminium Alloys		
BS 1470. HS19W.		
Sheet 10 S.W.G.	„	3 3
Sheet 18 S.W.G.	„	3 5½
Sheet 24 S.W.G.	„	4 1
Strip 10 S.W.G.	„	3 3
Strip 18 S.W.G.	„	3 4½
Strip 24 S.W.G.	„	4 0½
BS1477. HP30M. Plate as rolled	„	3 1
BS1470. HC15WP.		
Sheet 10 S.W.G.	„	4 3
Sheet 18 S.W.G.	„	4 8½
Sheet 24 S.W.G.	„	5 8½
Strip 10 S.W.G.	„	4 4
Strip 18 S.W.G.	„	4 8½
Strip 24 S.W.G.	„	5 4½

		£ s. d.
Aluminium Alloys—cont.		
BS1477. HPC15WP. Plate heat treated	lb.	3 10½
BS1475. HG19W. Wire 10 S.W.G.	„	4 2
BS1471. HT19WP. Tubes 1 in. o.d. 16 S.W.G.	„	5 5
BS1476. HE19WP. Sections	„	3 4
Split tube		
19 S.W.G. (⅛″)	„	4 2
20 S.W.G. (⅛″)	„	3 11
21 S.W.G. (⅛″)	„	4 1
22 S.W.G. (¼″)	„	4 11
Welded tube (sizes ½″ to 1½″)	„	3/10½ to 5/8½
Brass		
Tubes	lb.	1 9½
Brazed Tubes	„	3 1½
Drawn Strip Sections	„	3 1½
Sheet	ton	190 15 0
Strip	„	190 15 0
Extruded Bar	lb.	1 11¾
Condenser Plate (Yellow Metal)	ton	182 0 0
Condenser Plate (Naval Brass)	„	196 0 0
Wire	lb.	2 8½

		£ s. d.
Beryllium Copper		
Strip	lb.	1 4 11
Rod	„	1 1 6
Wire	„	1 4 9
Copper		
Tubes	lb.	2 3
Sheet	ton	261 15 0
Strip	„	261 15 0
H.C. Wire	„	281 5 0
Cupro Nickel		
Tubes 70/30	lb.	3 8⅜
Lead		
Pipes (London)	ton	103 5 0
Sheet (London)	„	101 0 0
Tellurium Lead	„	£6 extra
Nickel Silver		
Sheet and Strip 10%	lb.	3 11½
Wire 10%	„	4 4½
Phosphor Bronze		
Wire	„	4 2⅛
Titanium (1,000 lb. lots)		
Billet 4½″ to 18″ dia.	lb.	47/- 48/-
Rod ¼″ to 4″ dia.	„	85/- 53/-
Wire ·036″-232″ dia.	„	159/- 99/-
Strip ·001″ to ·048″	„	350/- 68/-
Sheet 8′ × 2′. 20 gauge	„	73/-
Tube, representative average gauge	„	198/-
Extrusions	„	90/-
Zinc		
Sheet	ton	109 10 0
Strip	„	nom.

FOREIGN QUOTATIONS

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

Belgium	fr/kg	£/ton
Copper: electrolytic	31.00	226 11
Tin	132.30	966 19

Canada	c/lb	£/ton
Aluminium	24.00	194 8
Copper: electrolytic	30.00	243 0
Lead	10.50	81 0
Nickel	70.00	567 0
Zinc: Prime western	12.00	97 4
High grade 99.95	12.60	102 1
High grade 99.99	13.00	105 6

France	fr/kg	£/ton
Aluminium	2.43	179 11
Antimony 99·0	2.80	206 18
Cadmium	16.25	1,200 17
Copper: electrolytic	3.19	235 14
Lead	.93	68 14
Nickel	9.00	665 2
Tin	13.53	999 17
Zinc: Thermic	1.07	79 1
Zinc: electrolytic	1.15	85 0
Scrap		
Copper: electrolytic	2.85	210 12
Heavy copper	2.85	210 12
No. 1 copper wire	2.70	199 10
Brass rod ends	2.12	156 13
Zinc castings	.87	64 5
Lead	.87	64 5
Aluminium	1.80	133 0

Italy	lire/kg	£/ton
Aluminium	370	216 1
Antimony 99·0	485	283 4
Copper: wire bars 99.9	450	262 16
Lead	165	96 8
Nickel	1,300	805 14
Tin	1,840	1,074 11
Zinc: electrolytic	181	105 15
Scrap		
Aluminium soft sheet clippings (new)	305	178 2
Lead, soft, first quality	137	80 0
Lead, battery plates	77	45 19
Copper, first grade	370	216 0
Bronze, commercial gunmetal	420	245 7
Brass: heavy	275	160 12
Brass: light	260	152 16
Brass, bar turnings	275	160 12
Old zinc	107	62 10

Switzerland	fr/kg	£/ton
Aluminium	2.50	210 5
Copper: electrolytic	2.82	237 3
Lead	.80	67 5
Nickel	7.70	647 11
Tin	11.65	979 15
Zinc: High grade 99.99	.99	83 5

Japan	Yen per metric ton
Scrap	
Copper: electrolytic	288,000
Copper wire No. 1	262,000
Copper wire No. 2	255,000
Heavy copper	252,000
Light copper	237,000
Brass, new cuttings	197,000
Red brass scrap	218,000

West Germany *Scrap*	D-marks per 100 kilos	£/ton
Used copper wire	220	200 8
Heavy copper	216	196 15
Light copper	190	173 1
Heavy brass	145	132 1
Light brass	110	100 5
Soft lead	50	45 11
Zinc	50	45 11
Used aluminium unsorted	90	82 0

United States	c/lb	£/ton
Aluminium	24.00	191 5
Antimony 99·0	32.50	259 0
Cadmium	160.00	1,275 4
Copper: electrolytic	31.00	247 10
Lead	11.00	87 13
Nickel	81.25	647 11
Tin	121.00	964 7
Zinc: electrolytic	12.50	99 12

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ISSUED CAPITAL *	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 10 OCTOBER	+RISE—FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1961 HIGH	1961 LOW	1960 HIGH	1960 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	29/6	—6d.	11	9	7 9 3	33/9	26/3	35/-	26/6
400,000	2/-	Anti-Attrition Metal	1/3		NIL	4	NIL	1/3¾	0/9	1/6	0/9
43,133,593	Stk. (£1)	Associated Electrical Industries ...	30/1½xd		15	15	9 18 3	54/10½	29/3	67/3	38/3
3,895,963	1	Birfield	62/-	—1/3	10	15‡	3 4 6	78/9	45/-	51/3	29/-
4,795,000	1	Birmid Industries	75/6	—6d.	20	20D	5 6 0	103/-	71/3	74/9	56/-
8,445,516	Stk. (10/-)	Birmingham Small Arms	20/6	+6d.	17½QT	12½	5 10 0	36/10½	19/4½	30/6	18/3
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	12/6		5	5	8 0 0	14/6	12/3	17/4½	14/9
476,420	Stk. (£1)	Ditto Cum. B. Pref. 6%	15/6		6	6	7 14 9	17/6	15/6	20/-	17/1½
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	16/-	+3d.	6	6	7 10 0	18/-	15/3	21/1½	17/7½
18,846,647	Stk. (£1)	British Insulated Callender's Cables	56/6	+6d.	13½	13½	4 15 6	62/3	49/-	61/4½	47/-
7,670,837	5/-	British Oxygen Co. Ltd., Ord. ...	16/9	—9d.	16D	16	3 6 6	28/4½	17/-	35/-	19/10½
1,200,000	Stk. (5/-)	Canning (W.) & Co.	14/3	—9d.	15⅝	25+*2½C‡	5 1 6	20/9	13/7½	19/9	13/7½
60,484	1/-	Carr (Chas.)	1/1½		NIL	12½	—	1/7½	10½d.	2/3	1/-
555,000	1	Clifford (Chas.) Ltd.	29/-		12	10	8 5 6	31/-	26/-	35/-	28/9
45,000	1	Ditto Cum. Pref. 6%	15/-		6	6	8 0 0	15/3	15/-	16/- ◆	15/10½
1,166,000	Stk. (2/-)	Clifford Components V	8/-		25*2½C	25*2½C	6 5 0	10/1½	7/3	11/9	6/10½
300,000	2/-	Coley Metals	3/1½	—1½d.	15	15	9 12 0	4/5½	3/-	5/-	3/4½
10,185,696	1	Cons. Zinc Corp.†	62/6	—1/6	20	15	6 8 0	81/6	61/3	80/9	59/6
5,399,056	5/-	Davy-Ashmore	40/-	+1/9	27½	22½	3 8 9	44/6	32/6	147/3	99/6
8,000,000	5/-	Delta Metal	21/6		20	17½	4 13 0	27/7½	19/9	28/3	18/6
5,296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	37/3	—6d.	15	15	8 1 0	52/3	36/6	56/9	45/-
1,155,000	1	Evered & Co.	43/6		10	10 ϕB	4 12 0	45/9	42/6	42/9	29/3
18,000,000	Stk. (£1)	General Electric Co.	25/9	—3d.	10	10	7 15 3	39/6	25/6	47/9	29/-
1,500,000	Stk. (10/-)	General Refractories Ltd.	52/9	—6d.	25	20	4 14 9	65/-	42/9	52/6	40/-
937,500	5/-	Glacier Metal Co. Ltd.	17/-	—1/3	15	13	4 8 3	21/1½	13/9	16/1½	11/1½
2,750,000	5/-	Glynwed Tubes	24/6	+1/1½	22½	25¶	4 11 9	30/3	23/-	27/6	17/-
7,228,065	10/-	Goodlass Wall & Lead Industries ...	30/-		15	19L	5 0 0	44/9	29/-	41/9	33/-
696,780	10/-	Greenwood & Batley	16/3		15	30‡	9 4 6	29/6	16/3	33/6	29/1½
792,000	5/-	Harrison (B'ham) Ord.	9/-		*10	*20‡	5 11 0	14/6	8/9	15/10½	11/9
150,000	1	Ditto Cum. Pref. 7%	18/-		7	7	7 15 6	20/4½	18/-	23/6	22/-
1,612,750	5/-	Heenan Group	13/6		13	15	4 16 3	17/1½	10/6	13/-	9/10½
251,689,407	Stk. (£1)	Imperial Chemical Industries ...	60/-	+9d.	13¾	11½	4 11 9	81/6	59/3	76/6	54/-
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	14/9		5	5	6 15 6	16/-	13/10½	18/-	15/4½
29,196,118	**	International Nickel	145		$1.60	$1.50	1 17 6	160	104	105	84¾
6,000,000	1	Johnson, Matthey & Co.	67/9		15	12	4 8 6	75/-	57/6	67/6	44/9
600,000	10/-	Keith, Blackman	17/6		17½	17½E	10 0 0	21/6	16/6	32/6	17/6
320,000	4/-	London Aluminium	11/6		13	12	4 10 6	15/-	8/6	12/6	7/10½
1,530,024	1	McKechnie Bros. A Ord.	32/6	—1/3	12½K	17½F	7 13 9	53/3	32/6	69/3	55/-
1,108,268	5/-	Manganese Bronze & Brass	11/6	—1/-	20⅝	20⅝	9 0 0	18/6	10/9	18/6	13/4½
50,628	6/-	Ditto (7½% N.C. Pref.) ...	5/3		7½	7½	8 10 6	6/-	5/-	6/6	5/9
26,361,444	Stk. (£1)	Metal Box	82/6	+5d.	12	12M	2 18 3	100/9	69/3	84/3	61/-
415,760	Stk. (2/-)	Metal Traders	7/6		50	50	13 6 9	8/9	6/9	10/9	7/1½
240,000	1	Mint (The) Birmingham	33/9		15G	12½	5 18 3	35/9	24/-	39/-	33/6
80,000	5	Ditto Pref. 6%	71/6		6	6	8 7 9	77/6	71/6	80/-	75/-
274,152	1/-	Minworth Metals	5/6		30	30S	5 9 0	6/3	4/6¾	5/2½	3/10½
5,187,938	Stk. (£1)	Morgan Crucible A	60/3		14	13	4 13 0	71/3	53/4½	63/-	47/6
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	14/6		5½	5½	7 11 9	17/-	13/10½	18/9	15/9
3,850,000	Stk. (£1)	Murex	40/-		13	22½J	6 10 0	52/-	39/6	45/-	35/3
585,000	5/-	Ratcliffs (Great Bridge) Ord. ...	16/-		10	10R	3 2 6	16/6	15/9	17/-	14/9
1,064,880	10/-	Sanderson Kayser	35/-	+1/3	17½	35‡	5 0 0	41/3	29/-	40/3	27/7½
3,400,500	Stk. (5/-)	Serck	14/6	—3d.	12½	17½GD	4 6 3	19/3	14/1½	25/6	15/3
212,384	5/-	Stedall & Co.	7/9		15	15	9 13 6	10/3	7/6	10/3	6/3
8,035,372	Stk. (£1)	Stone-Platt Industries	50/3	—6d.	16	15	6 7 6	67/-	50/-	64/4½	52/3
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	14/6	+5d.	5½	5½	7 11 9	18/-	13/6	18/7½	15/3
35,344,881	Stk. (£1)	Tube Investments Ord.	57/-	—3/-	14	20	4 18 3	85/6	55/6	140/3	63/10½
41,000,000	Stk. (£1)	Vickers	27/3xd	—9d.	10	10	7 6 9	38/3	27/4½	39/7½	27/1½
750,000	Stk. (£1)	Ditto Pref. 5%	13/-		5	5	7 13 9	15/-	12/4½	17/6	13/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	18/3	+3d.	*5	*5	8 3 0A	21/1½	18/-	24/6	20/1½
4,594,418	1	Ward (Thos. W.) Ord.	68/3	—1/6	13¾	25	4 0 6	84/6	64/6	94/-	63/-
7,109,424	Stk. (£1)	Westinghouse Brake	29/3	—3d.	11	10	7 10 6	46/3	29/-	60/6	37/6
323,773	2/-	Wolverhampton Die-Casting ...	8/3	—3d.	35	30	8 9 9	13/4½	7/10½	13/10½	8/1½
591,000	5/-	Wolverhampton Metal	22/-	—9d.	32½	32½	7 7 9	30/-	21/3	39/9	23/9
156,930	2/6	Wright, Bindley & Gell	4/3		15	20‡	8 16 6	4/9	3/7½	4/6	2/10½
124,140	1	Ditto Cum. Pref. 6%	12/9		6	6	9 8 3	13/7½	12/9	15/-	13/6
150,000	1/-	Zinc Alloy Rust Proof	4/3	—1½d.	40	30	9 8 3	5/6	4/3	5/4½	4/-

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡and 100% capitalized issue. ◆The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. D and 50% capitalized issue. C paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. R and 33⅓% capitalized issue in 8% Maximum Ordinary 5/- Stock Units. ϕ and 6¼% from Capital Profits. B and 50% capitalized issue. G and 50% capitalized issue. F and special 5% tax free dividend and 50% capitalized issue. ¶and 3 for 7 capitalized issue. L and 33⅓% capitalized issue. M and 10% capitalized issue. J and 75% capitalized issue. Q also 1/- special tax free dividend and 50% capitalized issue. T Per £1 unit. K Forecast dividend. S and 50% capitalized issue. V incorporating Clifford Covering.

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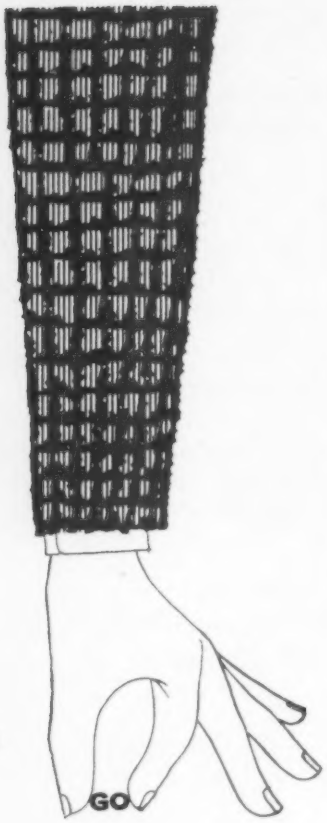

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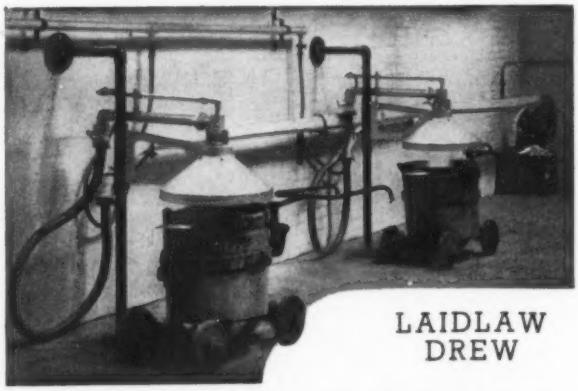

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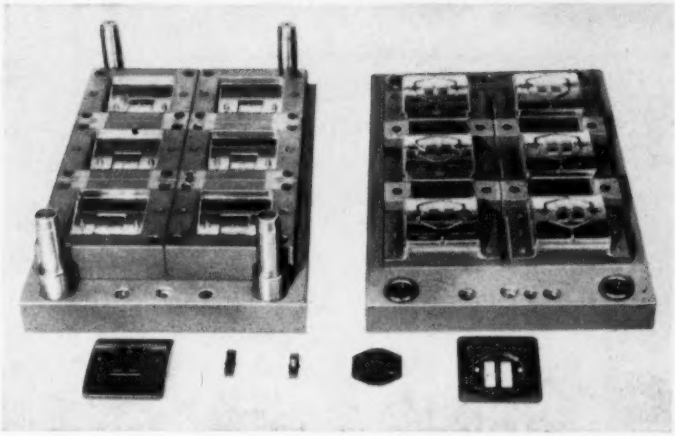

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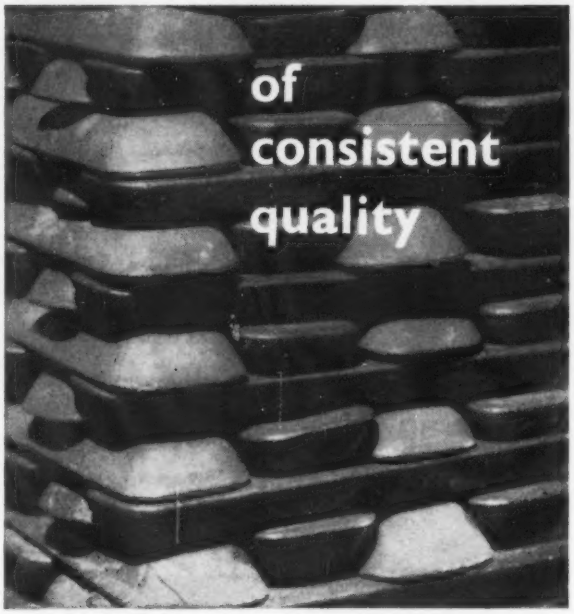

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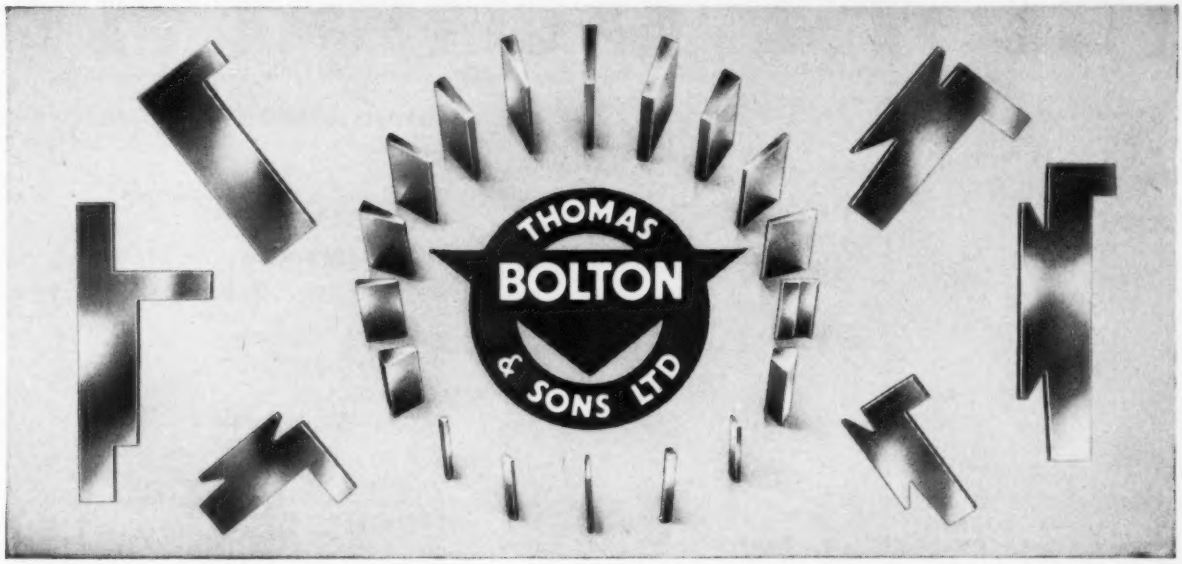

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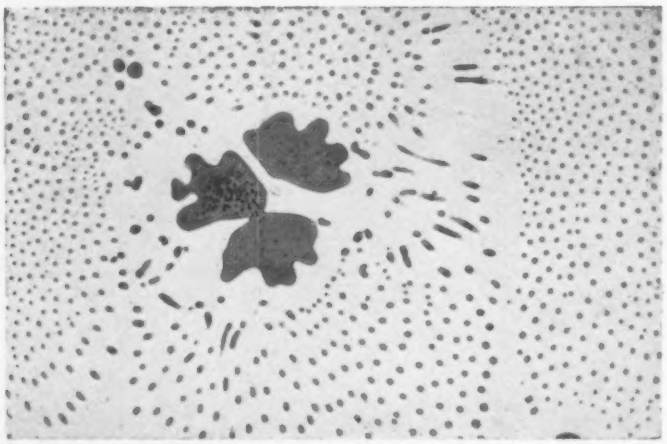

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